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ABSTRACT

In response to the increasing social concern for the quality of the environment and its conservation, and the need to ensure that all pupils in their final years of schooling be brought to share that concern, teachers in Hertfordshire, England, have constructed an 'A' level curriculum or syllabus of environmental studies for the sixth form. Based on an interdisciplinary approach, the studies enable students to examine the ecological interrelatedness of the environment and the place of man, the impact of human society on the environment, and the possibilities of management and control. Presented in this report is a review of the emergence and present state of environmental studies in Britain followed by an assessment of the theme or content of environmental studies/sciences. The approach to such studies is discussed from various points of view: sociological, biological, urban--rural, and world conservation problems. Subject information and teaching notes for the syllabus are developed in four sections: (1) processes and systems of the natural environment and the limits of the resource base, (2) the ecosystem, (3) the interaction of man and the environment, and (4) environmental conflicts and planning: a field study. Criteria for examinations and an extensive list of resource materials are also included. (BL)

Compiled by S.McB. Carson

Environmental studies

The construction of an 'A' level syllabus

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Hertfordshire County Council Education Department

National Foundation for Educational Research in England and Wales

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Preface

SOCIAL demands on the schools, developments in educational thought and the consequent movement for curriculum reform all exert pressure for change on the teaching profession, and by way of response teachers are expected inter alia to study aspects of curriculum design and development, to devise appropriate teaching materials and to increase their skills in techniques of assessment. The work of the Hertfordshire 'A' Level Environmental Studies Working Party is an illustration of such a response. It is a response to the increasing social concern for the quality of the environment and its conservation; to the need to ensure that all pupils, including the most able, in their final years of schooling shall be brought to share that concern; and therefore, the teachers think, to the need for an 'A' level qualification in Environmental Studies suitable for entry into higher education and for certain career opportunities. Finally, it is a logical progression from the 'O' level and CSE examination curriculum that has been developed in Rural and Environmental Studies.

The endeavours of the Hertfordshire teachers to devise an 'A' level syllabus in Environmental Studies originated in 1966 with the work of Paul Topham, then Head of the Department of Rural Studies in the Shephalbury School, Stevenage. In the sixth form he arranged and taught a syllabus in Environmental Studies that attracted the ablest pupils who had completed appropriate 'O' levels in the fifth year, even though it was not possible to examine their work at 'A' level.

It is interesting to note that a subsequent survey of Rural Environmental Studies in comprehensive schools undertaken by the NRESA showed that in some comprehensive schools, able pupils were attracted into these courses up to 'O' level and subsequently succeeded at 'A' level in associated subjects.

Between June 1967 and November 1969 Paul Topham had a first set of proposals for an 'A' level syllabus in Rural Studies under consideration by an Examining Board and the Schools Council. The

first submission was unsuccessful. In March 1970 a submission was made to the same Examining Board for an 'A' level syllabus in Environmental Studies, this time on behalf of a consortium of twelve Hertfordshire schools. That submission also was unsuccessful.

By now it had become clear that the nature and content of the syllabus ought to be considered further by a panel of sixth-form teachers, that extra specialist advice should be sought and that the opinion of various University departments ought to be canvassed. At this point, the County Education Officer decided to call a conference to which were invited University teachers (though many more representatives from the Universities wished to attend than it was possible to include), representatives of the Examination Boards, Colleges of Education, Professional Bodies, HMI, the Schools Council, and representatives of the Hertfordshire head teachers and sixth-form teachers who had started to meet as a working party to reconsider the syllabus. It was hoped that the conference would outline an appropriate area of study and that with this authority the Working Party might then devise a syllabus that could be presented with confidence to schools and examination boards. The work and outcomes of the Offley Conference, 23rd-25th October, 1970, can be read in the pages that follow.

The Working Party now embarked on a programme of discussions and workshops during the period 9th December, 1970, to 25th June, 1971. In a series of meetings lasting until March 31st, they outlined the functions which their proposals should fulfil and the objectives they hoped to achieve. They drafted and re-drafted the syllabus, prepared teaching notes, proposed methods of examining, and criteria for the examination of field work. Three drafts were circulated and comments were invited from all members of the Offley Conference and others who had asked to be kept informed. By this time correspondence had developed with over 150 concerned individuals and bodies, including Universities and other Institutions for higher education. All replies received were taken into account in subsequent discussion and re-drafting. Specimen question papers were prepared and validated with the help of Bloom's Taxonomy. During this period several colleagues from Universities, the Examination Boards and the professional bodies attended a number of the working sessions of the group.

To conclude the programme, it was agreed that nine members of the Working Party should be withdrawn from school for the period 7th to 25th June to hold a workshop in the Longmore Teachers' Centre,

Hertford, to compile book and non-book resources lists, again with the help of colleagues from the Universities and the professional bodies. Representatives of publishers and manufacturers of equipment and audio-visual materials also attended, and a large collection of resource materials was loaned by firms and libraries. When the resources lists were finally completed an exhibition of the books and materials was held for all schools interested in teaching the syllabus.

The Working Party hope that all schools who intend to teach this syllabus will make early submissions to their examination boards. Meanwhile, Hertfordshire schools have signified their intention of setting up courses based upon the syllabus, and the work of planning and implementation will go forward among these schools.

The group are conscious of the fact that considerations of breadth and depth, and the difficulties that some studies might present to pupils of this age range and maturity have led them to preclude certain studies from their syllabus.

However, they believe they have devised an area study which, though it derives academic content from a number of traditional subject disciplines, nevertheless constitutes a coherent and clearly defined field enabling the student to examine the ecological inter-relatedness of the environment and the place of Man, to study the impact of human society on the environment and the possibilities of management and control. To do this, the teacher and the student are involved in new teaching approaches. While new teaching approaches require fresh techniques of assessment, as the introduction to the syllabus points out, the limitations of present examination procedures were borne in mind by the group when proposals for the examination were being formulated.

The high cost of examinations involving field work is a major constraint on their expansion, and this problem, together with the need to ensure comparability, gives rise to a consideration of the need for teachers to develop necessary skills in assessment; of the training this would involve; and of the examination procedures that might be developed to use such skills.

At present considerable resources are being devoted to curriculum development that entails the production of material collated and written by teams of experts and sent out for trial teaching in schools. But the process of development undertaken by the Hertfordshire group is different; it is school-based and is the

result of initiatives taken together by practising teachers with the support of their local education authority. Such self-generated work offers a viable way of developing an area of curriculum, including syllabuses to 'A' level, and, to ensure its further progress, ought to attract the support and resources of the examination boards and the Schools Council. Indeed, examination boards might take an opportunity such as this to experiment in flexible methods of examining with the schools concerned.

Jack Kitching
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Mr. D. J. Lewis (" " " " ")
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Mr. E. J. Douglas (Hadham Hall School)
Mr. R. C. Gwilliam (Monks Walk School)
Mr. A. H. Hayward (Cavendish School)
Mr. P. Jackson (The Highfield School)
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Mr. P. Lord (Hitchin Girls' Grammar School)
Miss M. Sherratt (Presdales School)

Chapter One: Environment and Exams

Introduction to the Conference

S. T. Broad

WHY are we concerned about environmental studies? 'The general position is that there are today countless men and women armed with the means and the motive power to transform the nature of the countryside, who lack entirely a knowledge of ecological principles, and who, in their ignorance, can take action to damage irreparably our natural resources and destroy our natural environment. Today the farmer, chemist, planner, builder, industrialist, engineer, civil servant, and members of parliament or of local authorities, are all in this position of power at various times and in varying degrees. When we add to these the great mass of the population who, with greater leisure and great ability to move about, hurl themselves each weekend into the countryside without even a rudimentary knowledge about their environment, we should be amazed at our own stupidity as a nation'.[1]

We do not want to repeat the mistakes made in America where, after the shocks of the Tennessee Valley disaster, the impact of pollution in the Great Lakes and the smog of Los Angeles, the authorities planned a crash intensive course for teachers on 'conservation' principles and children were organized into courses on 'conservation'. This has not been successful and, as educationists, we think we know why. Good attitudes are built up only from a study of ecological principles and not from indoctrination. This takes time, and we cannot hope for colleges of education and universities to put the deficiency right without a sound basis in the schools on which to build.

As Mr Carson will no doubt tell you, after 25 years we have now recognized CSE and 'O' level courses in environmental studies. It is essential for schools now that there should be 'A' level courses acceptable for university entrance. For courses to succeed in sixth forms it is important for them to have academic respectability and

[1] BROAD, S. T. (1969) 'The educational aspects of nature and conservation', Advancement of Science, (Sept.)

validity, and this is often represented by examinations.

This conference has been called to do a job of work. We hope, as a result, to have an area of study called environmental studies or environmental science, clearly outlined, that will have the authority of this conference behind it, and which we can then present with confidence to schools and examination boards.

Decisions will have to be reached on controversial points. We may never get complete agreement on every detail, but some agreed core is essential to any further advance. Such definition must be realistic in terms of what schools can do with the resources, time and expertise available to them. It must lead to an 'A' level examination acceptable for university entrance.

It will have a wider and deeper effect in the schools because of the support which it will give to a whole range of courses at other levels. The conference structure has been designed to get a great deal done in the shortest possible time, and the chairmen of sessions and study groups have been charged to keep you to the points at issue. I hope and believe that with your help the schools can reach the best solution of these problems. If we cannot do it here in Britain, then, frankly, there is little hope for the rest of the world.

The Emergence of Environmental Studies

S. McB. Carson

I DO NOT propose to argue the case for environmental studies in schools but only to outline, as objectively as I can, the present situation and the events and ideas that have led to it.

There is nothing new about studies of the natural environment in schools. Some teachers have always been engaged in this sort of activity, certainly since the beginning of the century. But since about 1910 there had developed, in country schools, courses originally called rural science, which were an early attempt at investigating natural phenoma in a scientific way and at a level thought suitable for the elementary education of the period. Linked to these courses in many schools, and particularly during and after the first world war, were utilitarian courses in gardening and animal husbandry.

The dominance of one or other of these aspects, utility or education, often depended on economic factors, the need for rural families to be able to grow food, or on the teachers' own scientific interest. A political factor - an attempt to halt the drift from the land - was also felt at this time.

Gradually, and especially in the 1930s, educationists began to use rural science as the basis for the improvement of pupils' general learning; that is, they used these activities, which children enjoyed and which gave material rewards as incentives, to encourage arithmetic, science, geography, history or expression of speech and writing. There were a few schools where the whole curriculum was specifically integrated in this way. A Hertfordshire syllabus of 1929 exists as an example of this approach. Teachers became aware that the relevance to their needs that the children saw in this work sometimes resulted in a greater response than could be gained by more formal methods.

After the second world war, schools began to use the title 'rural studies' for such courses, which sometimes were widely based studies of the countryside, using what it had to offer to enrich the general education of the children. Sadly, in other schools this sometimes degenerated into straightforward horticultural or agricultural training.

Associations of interested teachers were formed in the 1950s, and in 1960 amalgamated into the National Rural Studies Association which now has thirty affiliated bodies. They were immediately concerned by the wide variations in courses existing under the name 'rural studies', some of which had little logical claim to that title.

In 1965, the first 'Countryside in 1970' conference was held at Keele University, and the various education interests concerned with the rural environment got together for the first time. As a result, teachers of rural studies began the exercise of relating their subject to the needs of the 1970s as they have gradually become more apparent over the last five years. Much dross has been removed in this process. A great many working conferences have been held and some research carried out, as a result of which there has arisen widespread agreement about a definition of studies of the countryside and their general content; this amounts to: a study of the countryside, landscape, soils; the plants and animals naturally present, their ecological relationship; the effects of man's activities, particularly farming and forestry, with an emphasis on land use and conservation.

Recently, however, since the formation of the Council for Environmental Education, it has become doubtful whether the traditional distinction made between rural and urban environments any longer reflects a real situation.

Other changes have been occurring also. The introduction in one form or another of less selection in education, and the rising standards in primary schools, have allowed more children the opportunity to follow courses at more demanding levels. As a result, courses not recognized as 'academic' have become less popular. So long as teachers of children of supposedly different abilities were segregated into different educational institutions, this was accepted. But when they came together, the irrationality both, on the one hand, of refusing individual advancement at grammar school levels to any child that proved capable at whatever age, and, on the other hand, of restricting to less able children courses or activities which had proved themselves in secondary modern schools, became apparent. So teachers of rural or environmental studies were able to offer their now relevant courses to children at all levels of ability.

I do not wish to be drawn into a discussion on the pros and cons of examinations and their effect on education; merely, for our purposes this weekend, to recognize the fact that, in the upper parts of secondary schools, examinations still largely control the curriculum, and that any course at this level must come to terms with this condition.

The CSE examination, being in the hands of teachers, allowed schools to present subjects that the established GCE boards had not previously accepted; and the 'overlap' by which a Grade I was recognized as equivalent to 'O' level caused a situation to arise in which pupils were gaining the equivalent of 'O' levels in environmental studies (or environmental science).

A quite separate development must now be considered.

In a number of schools that were formerly, or possibly still are, selective grammar schools, the re-thinking of curricula that had been occasioned by ideas of the abandonment of selection, as well as by other educational influences, had led to the setting up of integrated courses in a number of subject areas.

Some teachers of geography, history and biology, for example, had each come to see that their discipline did not offer children a complete explanation for the situations that they might investigate in the environment. Teams of teachers began to approach such problems together.

These courses inevitably began in the lower end of schools, sometimes with children, who, it was thought, were less able by the traditional academic standards of the schools. The logic of that is difficult to follow, I agree. But these courses have begun to spread and to raise the question 'Why cannot this more rewarding approach be continued in the upper school?' The immediate reaction was to look for a suitable examination structure.

Some other influences must be mentioned. The development of 'general studies' in sixth forms - open-ended activities and discussions on problems raised by the sixth form themselves - sometimes included studies of the environment; and evidence accumulated that the academic demands of investigations in environmental studies were comparable to the separate disciplines. Evidence of the position in comprehensive schools where candidates for 'A' level in biology had come up through CSE and 'O' level courses in environmental studies was obtained by a National Rural and Environmental Studies Association Working Party.

Traditional biology, geography and other courses were themselves changing as a result of modern re-thinking, and more fieldwork and direct enquiry were becoming accepted; boundaries were being blurred. The formation of attitudes and the construction of methods were being accepted as equal in importance to the factual knowledge of the content of the discipline. Studies in the field, whether from a geographical, biological, sociological or historical starting point, inevitably ran up against the controlled conflict of interests that we may call 'planning'.

Finally, without a doubt, a considerable impact has been made in schools by the 'Countryside in 1970' movement and the continuous press and television coverage of problems of conservation. This has touched sixth-formers particularly in a way that no other problem has since the early days of Aldermaston.

These various factors led a number of educationists to try and plan a sixth-form course in environmental studies and, to make this a realistic endeavour, an 'A' level syllabus had to be worked out.

Mr. Paul Topham, then teacher of environmental studies at Shephalbury School in this county, was, I think, the first to set up a sixth-form course at this level and to carry it through, although no 'A' level could be awarded. The evident popularity of this course and the interest it aroused led a number of other schools to agree that, were an examination available, they would follow suit.

Similar developments led to a similar situation in Wiltshire, in one area of the West Riding and in a school in Nottinghamshire. The National Rural and Environmental Studies Association has canvassed schools and found a genuine widespread interest. A number of formal and informal working parties were set up and approaches made.

They found that examination boards were very cagey about anything new being presented for 'A' level although, with the help of one board, they did get as far as agreement in principle with one of the Schools Council Committees involved. A number of papers, however, were rejected on various and, I must say it appeared sometimes, contradictory grounds.

Often the working parties were asked 'What evidence have you that universities would accept candidates with this sort of 'A' level?' and on making inquiries to universities, the reply was 'Show us some successful candidates and we will tell you.' A chicken and egg situation. Finally it was decided to contact the universities direct and to see whether there was sufficient interest and agreement on the subject for an attempt to be made to break the deadlock. Hence this conference.

The response has been extremely encouraging and, as the grapevine got to work, more and more inquiries for places reached us, so that we have been forced to refuse a number of faculties and have refrained from inviting a number of others that were suggested to us.

In addition to the universities we have invited a small sample to represent other forms of higher education - the colleges of education and the professional institutions concerned with town and country planning. This is because, as I am sure you all realize, although 'A' levels are designed primarily for university entry, they are inevitably used as qualifications for entry to certain professions at non-graduate level as well.

Finally, you are joined by a group of headmasters and sixth-form teachers, some of whom have been engaged on preliminary discussions to clarify the educational structure within which any of your recommendations must be framed.

A Report by Hertfordshire Teachers' Working Party

P. M. Jackson

IN HERTFORDSHIRE, the traditional way of examining areas of difficulty or of changing need, has been to set up a working party of interested specialists and ask for their recommendations. The members of the working party on environmental studies at 'A' level represent a wide range of specialist opinion. At the risk of some over-simplification, they fall into four groups:

(a) advisers from the County Education Department with a wide range of interest at all levels;

(b) teachers involved with new schools in the county where the need to design new courses and lines of study has (in some cases from the first year) stressed practical field work and encouraged an interest in the environment which is not present in every English school;

(c) teachers developing general studies courses in established sixth forms, or in new sixth forms where concern for the environment has become an important interest;

(d) (the heavy-weight group!) geographers and biologists who have been teaching in a traditional subject department but who have become increasingly aware of new areas of interest.

In presenting a report on their behalf, I would make it clear at the outset that we have not agreed a detailed report above formal signatures. Such an exercise would have little point because there would be a need to avoid the many controversial details. However, I would say that we have achieved a very considerable measure of agreement on the following:

1. Firstly, we have no doubt, as educationists, regarding the value of the studies to the individual and to society. I have in mind the increasing number of studies which are being undertaken now in schools in this county - studies which involve investigations of the environment at first hand.

In my own school, we have reached a point where, in each of the first three years, almost every student spends a week on a residential field study course. Having cut their teeth on this sort of work in the early years, students expect a similar approach in the upper school. We are by no means unique. I would emphasize that such courses are full of really hard work and are not, as some cynics have suggested, holiday trips. These are typical of the studies to which I refer. What is the value of such a study?

(i) involvement for the student - not always achieved in a classroom;

(ii) an open-ended scientific situation outside the laboratory;

(iii) a realism difficult to achieve in schools;

(iv) an opportunity for self-expression that is hard to find elsewhere;

(v) an integration of traditional school subjects which demonstrates clearly to the student that real life is not a mosaic of timetable subjects.

These are just some of the criteria which the working party would use to evaluate the studies. We are not alone in believing this to be worthwhile and I would draw your attention to:

(i) the pioneer work of the Field Studies Council, who have led the movement towards studies of the natural environment in an interdisciplinary way without any lowering of their high academic standards;

(ii) the various Nuffield science projects which take a direct enquiry approach;

(iii) the Schools Council environmental studies projects which have not yet reported, but which are using our schools in Hertfordshire;

(iv) the 'Countryside in 1970' movement which has done much to highlight concern at a popular level.

We could offer this as evidence that we have a subject that is worthwhile.

2. Secondly, the working party is agreed that students find great relevance in this area of study. Such courses are meaningful to their personal experience. Surely it is a sound proposition to have students who are satisfied, who want to learn because they are interested,

rather than because they are told they must. This could be a major educational advance, influential even at undergraduate level.

3. Thirdly, the working party is agreed that it would be quite unrealistic to ignore the part played by public examinations in our system. At CSE or GCE 'O' level there is no great difficulty. But in the sixth form, the absence of a satisfactory examination structure for environmental studies causes serious problems.

It leads to:

(i) the subject being offered as a 'minor option': a subject which has uncertain value and a weak currency; and

(ii) some wondering whether students would not be safer to follow the traditional disciplines like geography or the biological sciences. The working party is agreed, for the reasons I have given earlier when outlining the values we seek, that this is not a satisfactory solution.

The working party believes that it would be quite wrong to leave things as they are. Whatever we do, interest in the subjects by schools will continue. To develop a subject for which the present examination system is not structured requires both naive students and irresponsible teachers. As long as examinations are the status symbol in the sixth form, we must make it possible for students to pursue their studies without handicap. Thus the working party decided to go to the next stage: the consideration of a syllabus for environmental studies at 'A' level.

As soon as we come to consider this, we find ourselves trying to define the aims of 'A' level. We would suggest that if this conference wishes to avoid a repetition of our mistakes, they do not try this exercise. We are quite sure that any definition that we might provide would be different from that provided by the Schools Council or the Vice Chancellors or the Dainton Committee. We simply made the following assumptions:

(a) that this is a public examination for students at about 18 years of age;

(b) that we are talking about a 'major' subject;

(c) that the subject will require a two-year course which will produce intellectual stimulation; will make academic demands and will develop such qualities as originality in thinking, the ability

to follow a logical argument, social responsibility and, not least, hard work;

(d) that the course will receive positive encouragement from particular faculties so that a candidate with a high grade in the examination will have a qualification that is sought after by departmental staff in universities.

When we reached this point, it became clear that, although we have a good idea of what an environmental studies syllabus might look like, we needed help. In crude terms, we must consult the customer and get his ideas of what the product should look like in detail.

The first thing that must strike you, as we have already discovered, is the tremendous breadth of the subject. Your own varied interests make my point. Before us is a very wide spectrum. Perhaps at the one end we have matters of sociological concern; at the other end, interest in the natural environment from the point of view of strict ecological studies. Between these extremes - if they are extremes - lie studies of the rural and urban environment. In depth we vary from the world-wide picture to the local scene. Then again, one wonders whether it is possible to consider the position today without reference to history in any locality. I could go on.

The working party would like your opinion on a number of points:

1. What are the sensible and realistic boundaries of the subject - always remembering that, although boundaries are arbitrary, they are nevertheless necessary?

2. Are there basic principles in this study which can be stated and which we can have in our minds whenever we are considering particular facets?

3. Is there a difference between environmental sciences and environmental studies?

Mr. Broad said earlier that the conference had been called to do a job of work. The working party think that the job lies in providing answers to these and similar questions.

This may possibly be an historic occasion. It is not very often that a new discipline is injected into the English system of education. The working party think that environmental studies has a number of special qualities to offer and we hope that, as a result of this conference, we may provide a framework that will encourage students to involve themselves with the entire human environment.

Discussion

MR. MELVILLE: I have some experience of teaching planning at universities and now at a polytechnic and am interested in the whole question as a consumer. There are obvious opportunities for people who have taken some broad course in environmental studies. For example, going on to do a planning course. Then there is the wider question to think about, not just of what to do for the universities or professions, but of what society wants. There are various levels of involvement. For instance, I am engaged at one level as a teacher, but, at another, I would want to be a responsible participant in a democratic society.

PROFESSOR NEWBOULD: Our entry requirements for environmental science in university may be of interest. Geography and biology are the usual 'A' levels. I feel that an 'O' level in maths is also essential. 'A' level biology is essential, but not necessarily an 'A' geography. We would like more physics and chemistry but this is not likely to come. Will 'A' level environmental studies substitute for biology? I am not clear about this. Biology and geography 'A' levels will continue to be the main intake, I think, but how will this new subject adjust to existing subjects? It might be necessary to adjust the boundaries between the subjects.

DR. HEALEY: I assume a course with a geographical basis but with biology included. I agree that boundaries need careful definition.

DR. TAYLOR: Chemistry, physics, mathematics, biology - 'A' levels in three of these are essential for our courses but we will accept an 'A' level in geography. We would welcome an 'A' level in environmental studies.

MR. OSWALD: Other faculties besides the environmental science faculties themselves may like to have students with a wide 'A' level course in environmental studies. In fact they might prove a bigger market for such students, while environmental science faculties might prefer students with several traditional 'A' levels.

PROFESSOR HUNTER: There are two courses at Lancaster. The emphasis is on the physical processes of the environment, including the solar system as a whole. It is imperative to have a maths 'A' level for this course. Our alternative course is a combined honours in environmental sciences and physics. I represent environmental science. One of the problems is that we all have a different interpretation of what we mean by environmental science. We consider the interactions and boundaries between the topics important. Both our courses are an education in methodology. They deal with problems where the variables are difficult to control. The graduates are valuable in industry.

Maths 'A' level is our first priority, physics second, in considering students. We are intending to introduce an entirely separate course in environmental conservation which would include rural planning and land usage. For this course we would accept arts 'A' or mixed arts and science 'A' levels. We would hope that the two courses would interact and provide a range of topics within the department, among which students would select suitable material to fulfil their interests. For the present environmental science course in the department, 'A' level environmental science would certainly be eligible as an 'A' subject, but it would need to be backed with maths, physics and chemistry to 'O' level at least.

MR. YATES: I am a planner. Integration is important to us. Do we need to include, in a course, ideas of what we want to do with our environment based on an integration of subject areas?

MR. MELVILLE: We are looking at an adapted environment in process of change, an environment controlled by man. We are looking at the management of an evolving life-place relationship.

PROFESSOR HUNTER: I am convinced of the value of environmental studies on educational grounds but there is the difficulty of convincing the customer. The problem is that many customers, and in particular the Civil Service, want specialists. They don't want people with a general picture except for a very few at the top and these normally arrive there in the course of their professional experience.

PROFESSOR FUNNELL: We want to see graduates well set in a career and I agree that mostly specialists are ultimately required. Ours is a school of environmental sciences - we deal mainly with the physical environment. There is at the moment a lesser

component of planning and ecology. Able students with geography 'A' levels and one or two sciences at 'A' level are sought, but we have a proportion of 10 to 15 per cent students with arts backgrounds, 10 to 15 per cent students with pure science backgrounds, and the remainder with some science and geography usually. We don't cover what you call environmental studies at all in the sense of social studies. Maths in particular is important to us. I am rather uncommitted about environmental studies at 'A' level. We look for innate abilities rather than the content of the course of study in assessing a student for admission but we must be sure about their maths potential.

MR. DOUGLAS: As a headmaster, I accept that maths is essential for environmental sciences as for the other sciences at university, but we can't wait forty years for a broad basis to develop, our environment is in such a mess already. Environmental studies must be based on a biological background either in school or during the first year of university.

DR. HEALEY: We must keep this flexibility both at 'A' level and at university. There are human environment management outlets: planners, ecologists, teachers, architects. Environmental studies should be seen as a basis for future professional development in a wide range of fields.

MR. PARR: Irrespective of content it would appear that such a course offers opportunities for self-expression and integration of traditional subjects and this may be more important than subject matter.

DR. ROBINS: To a planning school, it would be more important for an environmental studies course to cultivate an attitude of mind towards environmental management, rather than toward the acquisition of ecological data.

MR. TILLOTT: There is interest in colleges of education. The development of environmental studies there is much more along the lines suggested by the last speaker - an educational exercise. The Associated Examining Board 'O(A)' syllabus may be unsuitable for the universities but in some respects it would suit colleges very well indeed.

PROFESSOR NEWBOULD: We would hope also to produce teachers who would teach environmental studies in schools, and thus that the circle would be completed. Planning is a team activity, but envir-

onmental science would produce a team that could converse with sufficient common vocabulary and concepts.

MR. SYKES: In discussing what sort of planners society needs, we are more and more looking to the specialist, not just the qualified general planner. In our planning department we have economists, sociologists and mathematicians. These first specialize, then go on to take a general planning course. An environmental studies at 'A' level may not give the opportunity to study one subject in depth.

MR. YATES: I do not agree. Planning is an understanding in depth of how you come to a decision on a number of problems in the environment. If students come to a wide understanding early in life, this will be of value. How far will this course go in the methods of study of integration?

DR. HEALEY: People are not flexible enough. We must make it an integrated course. What we really want are specialists with a general background.

MR. MELVILLE: Let us not use the word specialist. It is a loaded word.

MISS EDWIN: What is coming out of our discussion is the familiar tension between school courses based on pupils' needs and courses which meet university requirements. The first may be terminal ones and not necessarily suitable for pupils wishing to study that particular subject at a university. There has long been a similar situation in home economics. Candidates for a home economics course in higher education are often told that it is better not to take that subject at 'A' level, but to take science 'A' levels in preference.

MR. MELVILLE: In regard to the depth/breadth argument, it is too often assumed that higher education is deep, in the sense of having a range of intricately structured detail, and in the sense of complexity; yet God, or $E = mc^2$ (or whatever it is), is in certain senses both a broad and a profound concept. Too much attention is devoted by teachers to getting school children to analyse or even merely identify causes, and too little to seeing and foreseeing effects. The emphasis is on origins and not outcomes, motivation and not response, reasons and not responsibilities.

MR. SMITH: This is important to us in school. 'O' level has tried to serve three masters and has failed - a terminal examination, a vocational qualification and a preparation for 'A' level. 'A' level should ultimately serve only one purpose. It should identify a boy

or girl who is capable of the next level of academic study. Then society should provide the professional and other training and openings.

MR. PARR: As an admission tutor in a university department of town and country planning, I would applaud this. Does the content of 'A' level matter or is it just a case of passing the hurdle?

MR. HARTOP: Another value of a course is if it shows that a candidate has picked up a certain methodology.

PROFESSOR FUNNELL: I have some sympathy for the combined physics and chemistry course, or alternatively biological sciences, which have a methodology covering the same field as environmental science. Certain methodologies are common to many environmental sciences. It would be useful to combine the biological sciences with meteorology, etc., where there is some common methodology.

MR. HARTOP: Let us remember that the real customers are the pupils who will take this course. We should bear in mind the pupils rather than the universities to which they may well go. We should be able to clear our mind of various biases so that we can produce a course which is really meaningful and appropriate to these pupils of 16 to 18 years of age who will be living in this country in 1975 or whenever the 'A' level course starts. A second point is that, whilst I do not admit students to undergraduate university courses myself, I have never yet found a faculty that wouldn't accept a really good student whatever his background in 'A' levels.

MR. BROAD: Any course has to capture the imagination of the pupil. Children undoubtedly welcome an experimental approach and I would like to stress that the methodology which is developed nowadays in field work is of great interest to them. In a sense, the bulk of teachers are frightened of the new methodology and this is one of the obstacles to be overcome. Young people who want to come to universities and who are in sixth forms sometimes cannot appreciate the value of education, for they are under pressure simply to get 'A' level to get them into their field of study. What we have to decide is whether you would really like them to come to you with enthusiasm for these particular forms of study. There are teachers who are beginning to develop this approach, but we require from the universities more teachers equipped to carry it out.

Chapter Two: Problems of the Countryside

Introduction to the Session

Dr. R.H. Best

THIS IS, of course, European Conservation Year, and shortly the 'Countryside in 1970' conference opens. For several months now, we have been subject to over-exposure from such key words as conservation, pollution, environment. These words are becoming so commonplace that their meaning is being increasingly diluted. They now cover so very wide a variety of concepts and topics that sometimes I feel they have almost become meaningless. Each one of us may have radically different ideas from his neighbour on what is implied when these terms are bandied about. Herein lies a danger.

At this conference we are particularly concerned with environment, or rather environmental studies. One of our chief aims must be to try and sort out more clearly just what we mean by this term. There are several matters I would like to raise in this connection.

Environmental 'Science' or 'Studies'

Already I have been using the term environmental studies. But where new degrees or new school courses are concerned, the term environmental science is also employed - and seems to be used interchangeably for studies dealing with various facets of the environment. To my mind, however, these two terms are beginning to reflect a significant difference in approach to actual course-structure and composition.

If we go back for a moment to the original conception of environmental subject-groupings proposed in our newer universities, it is quite clear that the intention was to relate and combine the natural and social sciences concerned with the environment. For various reasons, this

intention seems, in practice, not to have been achieved. As far as I can see, the outcome has usually been very different and the resulting courses have fallen far short of the objective. Usually, there appears to have been a marked swing towards the natural sciences, and subjects like meteorology, geomorphology and oceanography have become predominant. Environmental science certainly seems an apt title for these degrees or courses. Perhaps our colleagues here from Lancaster and Norwich may like to comment on this and say whether my account is fair.

On the other hand, where a more equal balance can be attained between natural science and socio-economic subjects (as at Wye and at Waterloo in Canada), environmental studies may seem a more appropriate title. Here, I am going to stick my neck out and say that, if we are interested in the environment as part and parcel of human activity, surely we cannot confine our studies to the non-human sector. To me, environmental studies must include both the natural and socio-economic sides of the coin.

Rural Environment Studies at Wye

Needless to say, the new rural environmental studies degree, which we have started teaching at Wye only this month, falls into the category which considers both the humanized and the non-humanized environment. The background to this development may be of relevance to what we are discussing this weekend.

For many years, Wye (which is the School of Agriculture and Horticulture of London University) has taught degrees which, in many structural features, often resemble conventional geography degrees. For agriculture, relevant sectors of related disciplines (like biology, chemistry and soil science) are drawn upon and welded together with the mainstream subjects into a whole. And, most important, a considerable contribution is also made by economic subjects in addition to the range of natural sciences.

Consequently, the graduate produced is qualified to cope effectively not only with the scientific and technological aspects of agriculture, but also with the commercial attributes which are of such importance in the functioning of the farming industry today.

The reasoning behind rural environment studies is similar and extends down to 'A' level courses. I think we are all uneasily aware of the lack of real communication between specialists concerned with

environmental matters, who have been trained purely in the natural sciences or solely in the socio-economic field. Quite a few of you must have sat on committees or boards dealing with environmental topics. A lasting impression I have had on such occasions is the virtual impossibility of any real exchange of ideas between the two sides of the table.

Obviously, this is not very helpful, because the understanding and appreciation of the other man's point of view may well be vital for correct decision-making or policy formation. But how can we achieve it if one side doesn't know what the other side is talking about?

In the new Wye degree, therefore, a prime objective has been to get a more balanced approach to the whole environment. And in the course-structure, we have attained a roughly equal weighting between natural science and socio-economic subjects. There is a rather heavier load of natural science in the first year, but by the third year, socio-economic subjects and applied topics are more in evidence.

Theme of Environmental Studies

The unifying theme of the whole degree is land use, in its functional sense of man's activities and impace on the land surface, especially in a spatial context. And I suggest to you that this theme could very well provide the basic skeleton on which to hand any course in environmental studies.

I sometimes wonder if the problems of the countryside are as pressing as they are made out to be. We have to look at them carefully. There are a lot of land-use myths, so our objective in our degree course is to give both sides of any question, thus providing a more balanced view and a better perspective. For example:

1. Eighty per cent of England and Wales is still agricultural, and seven per cent is forest, making eighty-seven per cent rural in all. Only eleven per cent is urban - not a great deal in a highly urbanized society. This will be fifteen to sixteen per cent by 2000 AD. (The remaining two per cent consists of waterways etc.)

2. The loss of farm land is not always severe. Some parts of the country have seen little change - only one acre in 2,000 lost per year. Overall, the transfer is about one per cent per decade (40,000 now

compared with 60,000 in the 1930s). Since 1960 the greatest loss to urban growth has been in the North and West, not the South East. There is a fading away of the rate here.

3. We are not unique in our rates of agricultural loss either - Holland and West Germany have double our rate.

4. The impact of the loss of land on our food production is relatively small. A one per cent loss of land has to be set against a twenty-five per cent increase in agricultural output over the last ten years. A new Wye study suggests that we are all right for food until 2000 AD, provided better quality farm land is avoided for development and that incentives are given to farmers to keep output rising.

Through land use then, both the natural and the human aspects of the environment can be fused together. Following this reasoning, we have sub-titled our new rural environment studies degree: 'The natural, social and economic aspects of land use and conservation.'

Now, land use is another of these subjects which mean very different things to different people. We need to be fairly precise about it, therefore, and I have already given you a brief definition. In a little more detail, however, I would define it as follows:

'Land use is concerned with the spatial aspects of all man's activities on land, and the way in which the land surface is adapted, or could be adapted, to serve human needs.'

As you see, human actions are central to this definition. This criterion I regard to be of first importance, because it is often not accepted. Vegetation categories, for instance, or bio-geographical categories, are wrongly allowed to creep in.

Rural-Urban Interactions

There is another point about this definition which is worth stressing because of its relevance to our discussions. You will have noted that I said land use was concerned with the spatial aspects of all man's activities on land. This I must re-emphasize. Land use, conservation and geography itself have for a long time been dominated by essentially rural topics, for example land utilization surveys, and environmental studies have followed a similar pattern

It is interesting to see that, here in Hertfordshire, the new proposals for environmental studies at 'A' level have grown from courses in rural studies, with a considerable emphasis on subjects

like agriculture and horticulture. This sort of development has been paralleled at Wye with the new degree. But here, it seems to me, is another potential danger. We should not, I feel, let our thinking on environmental studies become dominated by just rural topics, and especially by agriculture and horticulture. We should be considering all man's activities on land, both rural and urban.

But equally, the impact of urban growth and urban activities on the countryside will form a substantial element in the teaching. Particularly in technologically advanced societies like our own, it becomes increasingly unrealistic and meaningless to draw a sharp distinction between 'urban' and 'rural'. There are exceptions to be made, naturally enough: urban land uses and rural land uses can be defined and distinguished, for instance. But on the whole - and especially where social and economic factors are concerned - it is more and more difficult and undesirable to press this twofold orthodox division too far. Indeed, the main problem of the countryside as I see it, is the impact on it of urbanization and the conflicts this involves - the interaction of both elements.

People move out to live in the country but commute to work in the towns. People living in towns or suburbs pour into the countryside in search of recreation and relaxation. And even in the countryside itself, in the agricultural industry, many of the processes which are altering the face of farms and farming have their source in urban pressures and demands. In other words, our urban and rural sectors are intimately inter-related. They are basically indivisible, and we should treat them as such.

Student Demand

However, whether we are dealing with so-called urban or rural areas, there is a growing consciousness of man's increasing impact on his environment, often a detrimental impact. Land use, conservation, pollution, planning, environmental quality - all these things stimulate growing interest and increasing concern at national and local levels.

This involvement of people seems to me to be reflected in the numbers of sixth formers who are channelling their choice of subjects away from more conventional patterns, and towards combinations of natural science and social science subjects. In this way, they can combine human and non-human elements in a manner that is impossible in a more specialist approach. This is very important and, of itself, gives an excellent reason for the forwarding of environmental studies as an 'A' level or degree course.

Summary

In brief, the main questions I have tried to put across, and which you might like to consider, discuss, and probably disagree about, are these:

1. Should we distinguish between the terms 'environmental science' and 'environmental studies' ? Do we wish to retain a reasonable balance between natural science and socio-economic subjects related to the environment in any courses we construct?

2. Could the unifying theme of an environmental studies course be land use, in its natural, social and economic aspects?

3. Do we wish to have a rural weighting in environmental studies, or should urban aspects be given a considerable valency? Is there, indeed, real distinction to be drawn between rural and urban in this context?

4. Is one of the main problems and topics to be considered in environmental studies the impact of the town, or urbanization on the countryside?

5. Finally, do students increasingly channel their choice of 'A' level subjects to those with a mixture of human and non-human content? Can environmental studies contribute to this apparent demand and provide a useful outlet?

Discussion

MR. STONE: The contribution of physical science and aspects of human science has been stressed, and you have mentioned particularly social and economic studies. At Loughborough we are concerned with the influence of the physical environment on human physiological and psychological responses. For an 'A' level syllabus, these would be very important aspects. With respect, I challenge your notion of human studies. I would have included a consideration of the influence of the thermal environment, of light, noise and vibration on people. Our degree course includes environmental ergonomics, and this sort of topic is dependent on a knowledge of physical science at least to 'O' level. There is a growing number of people who choose courses which enable them to explore knowledge in both natural and human science and who would like to make a contribution to real world problems from this basis.

MR. TILLOTT: Is it not desirable to have another such degree course called 'urban environment studies'; and would it be possible for it to follow a similar pattern as studies of the rural environment but have urban characteristics?

DR. BEST: In many senses it would be better to consider courses just as environmental studies without putting rural and urban tags on to them, for the reasons I mentioned. The course at Wye which I described comes in very much from the countryside angle, I agree; but, as I said, rural and urban studies need to be taken together, and this is why I really would be a little hesitant to suggest a course solely in urban environment studies.

DR. BRACEY: The title of the course at Wye included 'rural' but some of the content (how much was not clear) included urban factors.

DR. BEST: Yes. The problem is a simple one - staff and their qualifications. Ideally you might like to do a certain thing; in practice you can only go so far. We go as far as possible into the urban side - as far as resources permit.

MR. PRITCHARD: Eighty per cent of people live in towns; even pupils living in rural areas are brought into schools in town. As schools reflect the immediate society, they deal primarily with urban topics. The tendency is not to take account of the rural situation.

MR. TILLOTT: Would you accept a student for a non-graduate course who had history and economics and one other arts subject?

DR. BEST: Yes. The pilot course which has just started at Wye has an intake of eleven people. Several of these students have got history, English, economics and art at 'A' level as well as geography and a biological science; in other words, mixed 'A' levels. Some chemistry is useful too. We are hoping to develop, this year, a new half-unit in botany, for rural environment studies, which will bring in a wider range of topics than we have in the existing botany course. We would welcome an 'A' level in environmental studies as an entrance qualification for our new degree.

MR. TILLOTT: The 'A' level course described in the Associated Examining Board's 'O (A)' syllabus would seem to suit you very well indeed for Wye as it stands.

DR. BEST: Many universities may be well advised to produce rather

more of the short, or rather elementary, courses designed to fill in gaps in students' backgrounds at 'A' level. In the new degree, we teach introductory chemistry or botany according to need, often in small groups. One gets the chance to do statistics in the second year.

PROF. HUNTER: On the whole, university selection committees tend to place less weight on general courses such as physics and chemistry than on separate subjects. Similarly, employers tend to prefer a specialist degree which they understand rather than a broad degree, although all the emphasis from the educationists has been towards broadening the degree structures. We are working in a difficult situation where science departments are at a disadvantage in that the majority of students at present coming from school have an arts/social science background. It seems to me that there is something wrong at the school level, which is the cause, and that in a country highly dependent on technological development, something should be done to put this right.

PROF. NEWBOULD: Dr. Best is trying to put too much into his course. We have to offer students a good range of choices. We have been told that we all mean different things by environmental studies and environmental science, and so we should. There must be very genuine differences of emphasis, and this gives people genuine choice between universities. We attempt in a small way to overcome this by offering a wide range of degree programmes at Coleraine, for example, applied geography and economics, as well as environmental science: or biology, geography, human ecology, history and resource management. We have not tried to get the whole lot into one course.

MR. MELVILLE: We need to be clearer about the primary function of this syllabus. The theme put forward by Robin Best seems to me very relevant, especially in its integration of subjects. There is, of course, a practical difficulty: the urban world can be a fairly complicated thing to study, for 16- to 18-year-olds, and there is something to be said for concentrating on the more directly observable rural phenomena. But behind all the detail should be general concepts, enabling the student to realize the forces that operate on the environment. Schools can draw attention to them through any available examples.

MR. TILLOTT: There are those of us, perhaps, who would aim at a general education, whether for pupils at school or for non-graduates, by using a concept of environmental studies in which the scientific side, as described this afternoon, takes a much smaller part. On the other hand there are those who say we must prepare school pupils for 'environmental science' of the kind described by Dr. Best. Ought we to consider an 'A' level in both environmental studies and environmental science?

MRS. SHAW: Environmental science and environmental studies are being examined in an experimental form by several boards at 'O' level. These are entirely different concepts.

MR. MELVILLE: No. Let us combine the 'science' and 'studies' aspects, and ensure that education produces children who understand that the environment is totally related. The schools' dilemma seems to stem from a mistaken belief that one quantifies and attains rigour only in the natural sciences.

DR. BEST: These terms, environmental science and environmental studies, are certainly a problem in relation to course content. Students might tend to avoid environmental science if it had little human content. Should we just use the word 'environment' to describe a possible 'A' level course?

DR. BRACEY: Using the word 'environment' alone will not solve the problem. The report on environmental education being given to the 'Countryside in 1970' conference shows (a) that some would emphasize the natural environment while others would emphasize the man-made environment; (b) that some stress the need to understand man's biological and physical environment, others the need to promote a sense of responsibility for the environment; (c) that some view environmental studies as a method within an existing discipline or a group of disciplines, while others see it as the name of a new and developing subject, in its own right and in its essential unity. I think this formulation of the problem is valuable because it brings out three ways of looking at this subject by two kinds of person, giving, in all, six variations.

MR. BALE: As a sixth-form teacher, I try to take an interest in changing developments within geography. There is a tendency towards greater use of statistics, and an emphasis on urban geography.

How do you feel that your environment studies degree course would stand if we substituted the words 'economic' or 'industrial' for 'rural' and 'agricultural'? How would it then differ from a geography degree course?

DR. BEST: There are a number of points of difference. To start with, the first year is heavily composed of basic natural and social sciences taught by specialists - economics taught by economists, geology by geologists, and so on. In geography you obviously have to make do with staff only partly trained in these fundamental subjects. After this basic work in the first year, we get on to more applied aspects. Note that there is no element of regional geography in this degree: a largely systematic approach is intended, and certainly we don't mean to deal with specific regions as such. We will, however, have a course on tropical soils and land use, and other courses will deal more particularly with temperate areas. Even so, this is a fundamental distinction from geography. No separate course on cartography is included either. Land use is the basic concept to which the other subjects are orientated.

MR. HARTOP: It is difficult to see biology, geography and environmental studies as three reasonably unrelated 'A' level subjects, because the way in which geography is developing includes almost everything now suggested in the environmental studies syllabus. Parts of geography could be expanded to consume almost everything. The real answer to a unique environmental studies course is perhaps to be found in the suggestion that we had earlier in the discussion from Mr. Stone: that we think in terms of certain aspects of human psychology and their relationships with the physical environment. We may see here the link we are looking for. We start with human biology, especially physiology. From here we see how we observe the environment - perception. This brings in all aspects of the environment. In any explanation of this idea, we have to concern ourselves with the teaching of some psychology principles in schools. As members of the British Psychological Society will know, just recently there have been meetings on the problem of teaching psychology at 'A' level in schools. The proposal to develop an 'A' level syllabus has not yet been rejected, and indeed it is very likely that an 'A' level will be established. If you can teach psychology

to 'A' level, I am sure it is not difficult to teach what is required for an environmental studies course, particularly if you have a backing of practical work with which to fit it in. It may well be that the way in which your environmental studies course develops will be in a pupil-based manner. That is, starting from what they feel, their own perceptions of their environment.

MR. YATES: Can you take it a little further and suggest examination of the actions that may be taken in order to cope with changes to the environment? At a simple level, this could be done in school.

MR. HARTOP: One of the most important functions of education today is the distinction between understanding, skills and decision-making, whether at a personal level, in a group context or in a national context.

MR. PEEL: Among 'A' level pupils there is a tendency towards the social aspects of the curriculum. This can be seen in a college of education, where students can choose any two subjects out of eighteen. There is no difficulty in recruiting students for subjects with a social content at a much higher rate than for science subjects. This growth has taken place over a number of years now and there is no sign of a decline. The starting point for environmental studies may be from a number of different subjects, but it must lead to a common understanding of the environment. In the situation where we have to provide a flow of teachers to work in schools for 5- to 18-year-olds, we need students at colleges of education who are fundamentally interested in the environment. Proposals for 'A' level, especially along the lines following those suggestions at Wye, are welcome.

MISS BEALL: There would need to be some quantitative testing and evaluation involved in such a syllabus.

MR. BALE: Decision-making exercises, such as those involved in Mr. Carson's Conservation Game,[1] should be included. This simulated, in the framework of a game for use with pupils, a situation in which crucial decisions had to be made about the development of a given environment.

DR. BEST: The last speaker asked earlier about contrasts between

[1] A description of this game will be found in Walford, 'Geographical Games' (in the press).

the new Wye degree and more conventional geography degrees. I would like to emphasize this difference again. The main point is that there is the central theme of land use running right through it. In this sense it differs from the normal geography degree which sometimes seems to lack a real focus.

MISS BEALL: There seems to be a desire for a movement away from land use as a central environmental studies theme, and a focusing on man and environment.

DR. BEST: I would take this to be largely land use - man's activity on land.

MR. HARTOP: Land use studies seem to be similar to modern trends in geography. How far are we going on this? Do we start considering specific problems, economic or political? How far do we go along this line towards decision-making?

MR. TILLOTT: Go as far as you like. I would like students to be politically aware.

MR. MELVILLE: Certain things are core considerations, core themes, and the rest are contextual, which one develops only to the extent that is relevant for the course.

DR. HEALEY: There is a tendency in schools for syllabuses to be school-designed, as in CSE.

MR. CARSON: This is what we would like to see at all levels eventually.

MR. PRITCHARD: We would hope to be involved real-life situations, by using the environment wherever possible in our teaching.

MR. JACKSON: We need to remember that we are considering one 'A' level subject. Sometimes we have ranged further than just one 'A' level and looked generally at courses offered to sixth-formers who may want to go to university.

MISS EDWIN: We must limit the syllabus for any new 'A' level course.

DR. DOUGLAS: You may include studies in depth, and limit environmental studies courses to merely the physical aspects of the environment, or you can make it local environmental

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studies and embrace everything. Some geography departments still retain regional limitations in their courses. To have a scheme of environmental studies which is different from geography, such as wide-ranging environmental studies of the local area or of part of your immediate school hinterland, would create a new field of study which doesn't overlap too much with geography.

MR. BATE: I envisage great difficulties with the examination boards in getting an 'A' level course accepted, because each area would have a different syllabus in this case.

MR. MELVILLE: This is something to do with the examples one uses, not with fundamental issues, which have to be defined and developed. Different students in different parts might be subject to different experiences, but the basic principles would be the same.

MR. CARSON: Definition of the concepts is important, and so is delineation of the boundaries. This is our main task at this conference. Some things must finish up outside our boundaries if only for reasons of the limited time available in schools.

DR. KITCHING: 'A' level courses which include studies of the local environment, and which would be different from school to school, ought to be capable of assessment by examination boards. Perhaps the boards could tell us why they find this difficult.

MRS. SHAW: It would be possible to frame general questions which could be answered by pupils from their local experience.

MR. PRITCHARD: A problem arises because, it may be felt, some boards tend to analyse such a syllabus in a fragmented way. It may go before a geographical committee to be analysed for geographical content; or before a biological committee and examined only for biological content. Each one of these is then apt to consider that there is not sufficient of the material of its own discipline.

MISS HOPKINS: We must look for unity in construction in the syllabus.

MR. NEAL: This criterion is one by which acceptance is governed. The elements of unity and of depth of study are regarded as important. You cannot take one particular aspect in isolation from the examination as a whole.

MR. CARSON: Thank you, Dr. Best, for starting the conference on a topic that has led to us reaching the heart of the problem so quickly. It seems to me that the essential points raised are the balance of science and human studies to be included, the boundaries to be set and the unifying theme to be used.

Chapter Three: World Conservation Problem

Introduction to the Session

Professor P.J. Newbould

IN European Conservation Year I have been giving a gloomy lecture entitled 'Conserve or Perish', on the theme that unless man learns rapidly to limit his own population growth, conserve his environment and redistribute his resources more fairly, he will not survive into the 21st century. I will not repeat that lecture beyond saying that these are still the three main priorities of conservation.

Certain conservation problems are especially worldwide in their nature. They include pollution problems such as the worldwide distribution of excess radioactivity, of DDT, which has found its way to the Antarctic, and of SO_2 drifting from Britain to Norway. The use of resources, especially fossil fuels and metals, on a world scale is another major problem, and there are at present no international agreements regulating this. The conservation of habitats and wildlife is another world problem; at this level we are threatened with a serious loss from the gene pool, for it is more serious to lose a species from the world than to lose a local population. A small or poor country charged with conserving a rare species for the benefit of the rest of mankind may require international support.

Two areas where international agreements have been attempted are: whaling, where the International Whaling Commission is failing to achieve the conservation of whales; and Antarctica, where an effective agreement has been achieved.[1]

The problems of conservation on a world scale are especially 20th-century in nature because in this century the increasing population is pressing harder than ever before on finite resources, and improved travel and communications now allow everyone to see and know what is happening in other parts of the world. World

[1]Nicholson, E.M. (1970), The Environmental Revolution, London: Longmans

conservation cannot be effective without a much tighter degree of world government. Hopefully, the very seriousness of world conservation problems may itself promote a greater measure of international government.

The 'A' Level Syllabus

This conference aims to achieve an 'A' level syllabus for environmental studies. The problems in doing this include the functions of the 'A' level examination itself, which are much wider than university requirements, the relationship between this syllabus and other related 'A' level subjects, and the conflict of breadth and depth implicit in the subject of environmental studies. The latter is a very serious problem, for superficiality is so easily accompanied by a lack of comprehension; but how else can one cover the field?

It also has vocational implications. Society, especially future society, will require the Jack of all trades and master of one, the specialist capable of communicating both with other specialists and with the public.

I can offer only two partial solutions, consisting, firstly, of a strong unifying theme (the relationship between man and environment is insufficient since it means different things to different people); and secondly, of one example in depth.

Energy as a Unifying Theme

The unifying theme I propose is energy. It forms the basis of all meteorology and of geomorphology and hydrology, the cycle of erosion and deposition. It is the basis of all biology, the thing that keeps organisms alive, and the basis of forestry and agriculture and the accumulation of fossil fuels. The activity of industrial man can be described in terms of his use of energy. Here one might cite the energy-slave concept, the amount of work done by a man in a year as a unit of energy use per head. The world average is nine, USA citizens have fifty, Britain thirty, and India and Pakistan about one. It would be interesting to discover what we use ours for.

Energy is the only mode of interaction between an organism and its environment. To quote David Gates: 'The single most essential requirement of all living things is energy. Energy is the ability to work. Without energy no work is done and all life

processes would stop. Growth, cell enlargement, cell division, breathing, pumping of blood, translocation, chemical reactions and all other processes require energy. If the environment is to influence an organism, it must do so by energy transfer between the organism and the environment. There is no other process than energy transfer. All interactions can be reduced to an energy basis.'[1]

One can use the energy theme on many different time and space scales. Take man himself and his food intake: its calorific content is easily estimated: What is it used for? Resting, metabolism, work, excretion, defecation, keeping warm. These can all be quantified. Where does his food come from, and how does the energy get into the food? Alternatively, consider the fossil fuel reserves of the world, when and how fast they were formed, how far they have been used up and whether any more are being formed.

The approach can also apply to man-made situations, such as the energy budget, input and output, of a city; or the energy budget of a farm - input as solar radiation, tractor fuel, fertilizers, work etc., and output as food.

One Example

I want to mention one example which involves considering a variety of energy systems. It is the proposition that the present heat balance of the earth is a precarious balance between the heating effect of more CO_2 in the atmosphere and the cooling effect of more dust.

To examine this hypothesis one should first look at solar radiation, the solar constant of 2 cal/cm^2/min outside the earth's atmosphere and the various processes of attrition of this energy input: reflection, scattering, albedo, cloud formation and evaporation, 'black body' re-radiation from the earth's surface.

Then one would examine the carbon cycle, and the idea that in earlier ages there was more CO_2 in the atmosphere which subsequently became incorporated in organic matter by photosynthesis, and also in the carbonate deposits originating from marine organisms. Where, mainly because of water-logging, there is a failure of decomposition, the plant material formed by photosynthesis

[1] GATES, D.M. (1968), 'Towards understanding ecosystems', Advances in Ecological Research, 5, pp.1-35

accumulates as peat and is subsequently changed into coal, oil or gas, the so-called fossil fuels. As a result of these processes the CO_2 in the atmosphere has declined and the O_2 increased. The CO_2 content about one hundred years ago was 280 ppm, which is getting down quite near to levels at which it is limiting photosynthesis in many plants. Plants adapt to CO_2 levels, and the fact that many can photosynthesize more at higher levels may indicate their adaptation to former CO_2 levels persisting.

The CO_2 level has now increased to about 318 ppm and is currently increasing at the rate of 0.7 ppm per year.[1] This is attributable to three main causes: the use of fossil fuels, the use and chemical alteration of limestone and the clearance of forest to create grassland, with a diminution in the total organic biomass. The proportion of the increase attributable to these three is uncertain, though one can make some calculations from the better known components, such as the world consumption of fossil fuels. There is about sixty times as much CO_2 in the oceans as in the atmosphere, and it is not certain how long an increase in atmospheric CO_2 will take to equilibrate.

The increase in CO_2 has two main postulated effects. It may cause an unmeasurable increase in photosynthetic rates. It is also thought to affect the radiation balance of the earth by absorbing more of the long-wave re-radiation than of the incoming radiation. One possible effect of this would be the melting of the ice-caps and a rise in sea-level, possibly as great as thirty to forty metres. It would be an interesting exercise to examine the effects of this rise in sea-level.

Another process affecting radiation balance is the increasing dustiness of the atmosphere.[2] There is good evidence that this is happening. It seems to me inevitable that increasing energy use will anyway produce more heat, noise and disturbance, and the disturbance will produce dust. Cities, industries and the widespread savanna burning in Africa will all produce smoke. The increasing numbers of vapour trails from jet aircraft create additional cloudiness. One could try to estimate the orders of magnitude of these

[1] JOHNSON, F.S. (1970) 'The balance of atmospheric oxygen and carbon dioxide', Biological Conservation, 2, pp. 83-89.

[2] WENDLAND, W.M. AND BRYSON, R.A. (1970) 'Atmospheric dustiness, man and climatic change', Biological Conservation 2, 125-8

processes. They all have the potential effect of reducing the surface and therefore of causing cooling.

My suggestion therefore is that, in exploring the existence, magnitude and possible effects of increasing CO_2 and increasing dustiness of the atmosphere, one would need to examine many different energy systems, familiar ones like the coal fire and sea-level, and possibly unfamiliar ones like solar radiation and photosynthesis. This is only one example of an area to explore but I think it illustrates the potential of the energy approach.

Discussion

DR. DOUGLAS: Perhaps the concept of energy flow should be coupled with the cycles of water and matter. This we can relate to any situation or to any local problems.

DR. HEALEY: This approach can be a useful alternative as a teaching device but is not the only possible structure for the course.

MR. HAMMERSLEY: I wonder whether this approach is relevant to the needs of the pupil? Talking about the confrontation between environmental studies and environmental science, it seems to me that what we want is for pupils to understand which factors influence their environment. This would be more like a social study than a strictly scientific study. The real justification for this study is that it cuts across the discipline boundaries.

MR. TILLOTT: You spoke earlier of the distribution of resources in nature. It seems to me that the core of the problem is the evaluation of the distribution of resources in society.

PROF. FUNNELL: I don't feel that this argument has much to do with what Professor Newbould wants to get across. We should first show reasons why we must understand the principles of energy flow. The extraction industry is getting to all hitherto inaccessible parts of the world to extract increasingly diminishing resources of energy. This cannot go on for ever. The energy required for an advanced nation must at last run out, unless there is some breakthrough in nuclear research. At the same time, developing countries are requiring more energy also. Thus natural resources can be included in this theme.

PROF. FISHER: The arguments so far have introduced a good deal of

one point of view. Is this a satisfactory basis to approach sixth-form teaching? Surely we have to present many points of view. We should discuss political and sociological systems too. Would this offer an extra element of relevance?

PROF. NEWBOULD: I would not accept that sixth-form teaching should not be open-ended. But are ideas of energy too abstract to form the central theme of a syllabus? I do not think so.

DR. BEST: We seem to be getting back to the division I tried to point out between environmental science and environmental studies. I would contest this point that energy is a suitable theme for the socio-economic part of the syllabus.

PROF. NEWBOULD: If you put man at the centre, your theme would be the study of man's manipulation of the energy in the environment.

DR. BEST: We are only talking about the natural science aspects and not talking about economic and sociological studies.

PROF. NEWBOULD: An economic study can be included. For example, the energy input in modern agriculture is sometimes greater than the energy output in food production.

MR. MELVILLE: It comes down to the term 'physical resources', which brings us back to Robin Best's theme of land use.

MR. EYRE: I can see the possibilities of the energy theme, for example, in investigating reasons why certain societies have greater outputs, and pointing out that these cause more pollution. The energy theme could be a very good springboard for the social side as well as for scientific studies.

PROF. NEWBOULD: We are looking for one theme which will unify all systems we are involved in.

MR. PRITCHARD: Would such work present overriding difficulties, for example one, two or even three members of staff sharing a sixth form?

MR. STONE: I agree with Professor Newbould that the energy concept is extremely useful as a basic theme; one starts with an energy concept when considering the control of the interior environment in building. But I would like to hear him develop his theme on a systems analysis approach. The application of feedback and control

ideas would seem to be almost as general as the concept of energy; and systems analysis concepts are perhaps less abstract.

PROF. NEWBOULD: I think them more abstract. I am no expert on systems analysis, but we aim to make it the unifying concept for our environmental science programme at Coleraine and want to find out more about it. But I would have thought that, at 'A' level, talking about energy was less abstract, and that it was easier to give reality to the work of the course. But does it matter if we have slightly different unifying themes?

MR. STONE: It would be sad if you relegated systems analysis to a secondary role.

PROF. NEWBOULD: It is rather different from teaching energy flow terms.

MR. TILLOTT: It seems to me that the core of the problem is that when you have taught them all this, you may still have a sixth-form pupil turning round and asking 'so what?' Simply telling him the facts leads nowhere, because he is unable to alter the distribution of resources in society. For me, the unifying principle must relate to man's inhumanity to man, not simply to a description of man's ability to use resources.

PROF. NEWBOULD: There is a choice. We can prevent catastrophe. We have to work to limit world population as hard as we can, and if this succeeds we could then just about support, at the present world energy level, a state of life equal to about one-third of what we enjoy now in the West.

MR. TILLOTT: I agree that the nature of population pressures must be taught. But then, how do you attain population control? The problem, surely, is how to persuade society.

PROF. NEWBOULD: This has to fall outside the environmental studies line, I think.

MR. YATES: Is there a difference between the study of the management of our total environment and the study of the individual systems that make up that environment? We are concerned as human beings to try to manage our society so that we can all live reasonably well within it. This calls for us to integrate a variety of systems. We are concerned to introduce these ideas of what is involved in integrating systems to youngsters, at this stage. Let us think of this in

an integrated sense. School and university is only the beginning of this; it must carry on beyond. There is a need to teach everyone this throughout their initial ten to fifteen years of learning. Three or four ideas have come up: the study of energy and all that is involved; the study of rural and urban activities; the whole question of urban environment; and the human environment in general. This brings in psychology and human physiology and so on. It doesn't matter which way we do it so long as we get this integration idea across.

MR. BATE: I cannot foresee how we would get staff to do these sorts of things. Environmental studies has developed out of rural studies, history and geography, and I can see these aspects being developed in the sixth form very quickly. But what you are suggesting just now seems very distant, in the school situation.

MR. STONE: When a new course in Leicestershire was proposed for an 'A' level in design, teachers for the ergonomics content were not to be found. The department of ergonomics at Loughborough University arranged to give the teachers who would be concerned with this subject a two-day course, and supplied them with book lists for further study. In addition, the department is giving a set of lectures to all the first group of pupils as a 'one off' contribution to further assist the teaching staff of the schools. Universities could make contributions of this sort wherever a new 'A' level subject arises in which there is little or no previous experience in the schools.

MR. SMITH: Some solutions to your problem will emerge in the very process of setting up the studies we are envisaging. We want to send children to you still with minds which are completely open towards asking questions. Consider the overwhelming drama of man landing on the moon: they managed to find men who were able to respond successfully at every stage of a previously totally unchallenged situation, and who survived.

PROF. NEWBOULD: If you are suggesting that sixth-form teaching should be open-ended, I agree.

MR. SYKES: How could you devise a course in such a way that children were encouraged to ask questions rather than write down the answers? Children would not then learn it all parrot fashion.

PROF. NEWBOULD: I have been involved in one relevant experiment, though only at second hand. I have been trying it with primary school teachers, setting them to draw out children to experiment and discover. A visit was made to a peat bog from a local school (in Ulster). There, children investigated where the energy comes from that they found by burning peat; and from that has developed a whole range of inquiry. They can go quite a long way starting from the piece of peat.

MR. JACKSON: The working party, at one of our meetings, was satisfied with 'energy' as a unifying theme. We felt we could understand it and work with it.

MR. EYRE: It presented a great opportunity. It is lack of teacher initiative that leads to just presenting facts. I don't see why anyone in primary or secondary schools cannot go to a power station, for example, to study the use of energy resources and the production and distribution of electricity. It is not the syllabus which dictates the method of teaching but the teacher.

MR. PRICE: Energy cycles are a basic concept in the Wiltshire syllabus. We also deal with problems of the population explosion. In biology 'A' level, nowadays, teaching is very much based on energy, food cycles and so on.

MR. EYRE: It is not entirely a new approach in geography.

PROF. NEWBOULD: Until recently I had not realized that geomorphology could be considered in terms of energy. Tides and rivers are also energy systems.

MR. PRITCHARD: There is a possibility of developing environmental studies on the moral side, bringing the problem of the population explosion in. We must work out the moral consequences of these policies, for example is it good policy for us to have an ever-increasing population?

PROF. NEWBOULD: We have thirty energy slaves apiece in the West. How do we use these?

MR. TILLOTT: We do not really have them 'apiece'. They are not evenly shared out.

PROF. NEWBOULD: No, unfortunately.

PROF. FUNNELL: The whole social framework of the communities in less developed countries is such that in many areas they seem content to use energy at a relatively low rate, and this forms a stable society.

PROF. NEWBOULD: If you have as much as thirty energy slaves, you need an administrative system taking up about five of these to work them.

MR. TILLOTT: But to suggest that a stable society with low energy use can be planned is to ignore the historical context. Urban industrial society has arrived and continues to proliferate. There is no going back. The likelihood is that within a short time the whole world will be engaged in urban industrial activity.

PROF. NEWBOULD: It can collapse or progress or can consciously be slowed down. Can we define a central core of the syllabus based on energy? It could be arranged so that schools could then extend from this central core in different ways. We are looking for unifying principles. If you have a hard core, a good deal of flexibility is possible in the way in which it could be extended and explored.

MR. MELVILLE: We are talking about a wide range of resources. Ultimately they all involve energy. But we don't help by using the term energy as a way of describing them all. This doesn't solve the basic problem of producing a syllabus.

PROF. FUNNELL: In America recently I saw a poster saying 'Save your local planet'. The business of going to the moon has dramatized the earth's position in a larger situation. I suggest we start from the large scale and come down to smaller scales. As we bring the scale down, we get to the details of a local study to illustrate the broader principles.

PROF. NEWBOULD: Yes. But it might be said that if there are too many of us, we should go and live on the moon. If you think of this in energy terms, it is not on. What are the energy costs of sending one man to the moon?

MR. OSWALD: Most people don't understand the limited nature of resources. The average man, in my experience, seems to think that resources are things which are endless. The virtue of your approach is that it makes the limitations clear.

PROF. FUNNELL: Practically all resources could be presented as units of energy.

MR. MELVILLE: If we are to be effective we have to get the right level of aggregation clearly established. Neither ultimate particles nor the whole field would be useful here.

PROF. NEWBOULD: If we say we have a little bit of energy accumulated as fossil fuel from past years, we can perhaps grasp that it is a finite quantity. We could go on to introduce space and time dimensions and this would bring in distribution aspects. I see the social and political problems that are also involved, but I feel that life is too short, and one 'A' level is only one 'A' level.

DR. DOUGLAS: How do groups change when new technology is brought in? How is the same system modified in similar situations? When we come to a problem, we can examine all the contingencies and ask students about open-ended situations.

CHAIRMAN: We are getting away from the environmental studies syllabus.

MR. YATES: There are many interpretations of this term 'environmental'. Life is too short for them all. We are trying to give people a way of thinking in an 'A' level course, not necessarily trying to cover all the possible content.

PROF. NEWBOULD: We have to draw boundaries, as we have been told. The one essential is to have lines drawn logically.

MR. YATES: We in the planning courses are naturally interested in the views expressed here. We have to get students to think across the board and to bring them to see the links between different subjects. We have found that students with 'A' level often don't think in depth, and also find it difficult to see interactions between different aspects of society. This is what is now being suggested - that at 'A' level there should be a dual approach, part in depth and also across the board. In some ways it doesn't really matter what the central theme is, although I am very attracted by this theme of energy and how one manages it. What we have to do is to get people to think comprehensively as well as in depth.

Chapter Four: The Urban and Social Environment

Introduction to the Session

J. D. Fladmark

I DO NOT pretend to be an authority on education, and by way of introducing myself I ought to point out that I am rather a hybrid academic in that I am on loan to Edinburgh University from the Civil Service, where I am part of the staff of technical advisers to the Secretary of State for Scotland.

At Edinburgh University we are running a postgraduate course for planners, in the department of Urban Design and Regional Planning which forms part of the Faculty of Social Sciences. As you can see, we have not fallen into the trap of using the word 'environment'. The general line running through the course points in two directions: 'urban design' and 'regional planning'. We are fairly well committed to educating, apart from our own young planners, students from overseas. The main postgraduate course is an MSc course. This course, designed in consultation with the Town Planning Institute, is geared towards qualifying technicians or, if you like, specialists, to operate our planning machinery. At this stage I would like to explain the two basic ways we are training planners in this country at present, in postgraduate schools.

We rely on intake from a number of professions: geographers, economists, sociologists, engineers, surveyors. I do not think we have had any experience of students with an undergraduate qualification in environmental science in Edinburgh, but I am sure that when the time comes that someone turns up, he will be welcome. The other way of training planners is via an undergraduate course. People here may know more about this and can probably enlarge on it later. We have a non-graduate school of planning in Edinburgh, run by Professor Travis at the Heriot-Watt University, and, although I am not authorized to talk on his behalf, I am sure that he would be interested to train school-leavers with an 'A' level in environmental

studies or environmental science. But I don't think too much reliance should be attached to this, because there is only a limited number of schools with undergraduate courses, and the intake is thus small. There is a formidable number of applications for the Heriot-Watt course, and the intake is probably only fifteen students a year. I think that this last way of educating the planners is one which should be kept in mind by the teaching profession in devising this course. Here we have undergraduate courses basically designed according to the requirements of a profession; and although as yet there is very small intake, it offers a model for development and a possible goal for school courses.

With regard to the acceptability of 'A' level qualifications in environmental studies or environmental science, I, as a planner, would not be much concerned about the actual content of the syllabus. I would be more concerned with the approach to the subject. If this could introduce a synoptic view of the various factors in our environment, in whatever field, it would lay the foundation for the right kind of approach.

What I have said relates back to Mr. Jackson's two points, namely (1) educational satisfaction, and (2) recognition of a selection procedure for universities. With regard to point (2) we have a planning profession being trained at the moment which requires school leavers with the right kind of qualifications. But educational satisfaction is the most important point, in my opinion, and is related to wider and more general problems of our society than those of the planning profession. I have some practical experience of planning, and the conclusion I draw from this experience is that it is important for the planner to be able to work hand-in-glove with the public. This is not always possible, because of a lack of public awareness of environmental problems. We have gone a long way towards educating the planner; our job now remains to bring about a greater awareness among people about what planners do.

'Public participation' is a catch-phrase at the moment, and this is something we can latch on to, particularly since it is government policy. Whether local authorities are anxious to have public participation I would not like to say. This will vary from place to place. A document relevant to this is People and Planning, normally referred to as the Skeffington Report.[1] It gives us the whole

[1] SKEFFINGTON, A.M. (Chairman) (1969) People and Planning. Report of the Committee on Public Participation in Planning. London: HM Stationery Office.

background to how the public could be involved in planning.

Thus we can work at two levels: the professional level and the education of the public. It is impossible for the planner to achieve anything in terms of improving our environment unless he has got the public behind him. I do not think this is the case at present. There can be no doubt that there is a general lack of awareness. I will proceed by looking at the role of the planner and where his responsibility and work lies.

The planner can be looked at in two ways: firstly, as an arbiter between the individual and the public interest; secondly, as an environmental custodian. We have heard much at this conference to suggest that many people would like to think of themselves as environmental custodians. By that I mean that they have a foot inside the environmental camp. Planning is very advanced in this country; we probably have one of the finest planning machineries in the world. I was surprised that so little about town planning came out in discussions yesterday. The planner's responsibility is very complex, because what he is really concerned with is to form a continuum between the past and the present. It is said that the level of the arts of a nation is the direct reflection of the cultural performance of its society. Architecture is one of the formative arts, and society has often been judged by its architecture. I think that architecture has lost some importance in this respect, and would dare to suggest that it is gradually being replaced by planning as an indicator of cultural and democratic sophistication.

Planning constitutes a functional relationship with the environment. The second role, of meeting the environmental needs, represents another area of pressure similar to that between the individual and the public. I am thinking in terms of the legacy of the past and the pressure of technological change. A large proportion of the planner's work at the moment is to deal with an environment which was built during the industrial revolution. At the same time, he is confronting the pressure for change which is basically caused by technological innovation. The latter presents itself in the form of greater mobility, higher wages, more leisure time and so forth. The fantastic changes in new forms of communication are probably most important and are the main factor causing enormous pressure on the planner to provide new answers.

The present status of the planner is probably the key question in terms of what was discussed yesterday. At dinner last night one

of my fellow delegates asked what my profession was. I answered by saying 'I am a planner', and he retorted 'How sinister'. I think this is rather typical and rather unfortunate. The reason for this picture that many people have of the planner is due to the position he holds in the decision-making machinery. The academic planner may not be sinister, but we are not so concerned with him. The practising planner works either at national level or Local Authority level. His position at either level is basically similar. The decision-making process falls into these three stages. It starts with a technical decision, which is subsequently modified by the administrator and the politician in turn. The planner will initially make a decision based on a professional judgement but, with our democratic machinery, this decision is very seldom allowed to be implemented.

The administrator will assess his decision, to find out if it is administratively practical, and he will also keep in mind what is acceptable to the politicians. The decision is finally passed on to the politician, and normally he will not pay much regard to the professional judgement of the planner. I think his number one priority will be the political criteria. This is how the planner gets his rather unfortunate reputation, because, if something goes wrong with the decision, it is easily explained away by the politicians or the administrators as emanating from the planner. This is where public awareness comes into the picture. Mr. Jackson's second point, educational satisfaction, should be borne in mind. If we can bring the sixth-former out of school so that he can work hand-in-glove with the planner, we have achieved something, even if we haven't been able to form a sixth-form course which will equip him for professional training in planning.

In the planning profession we have this very tiny intake of a few university schools which take about fifteen students a year. It may be a line worth pursuing, in the committees who are aiming to devise these courses, to ask people who are involved in these planning schools to state their educational requirements. Latching on to something that is there, rather than looking for difficulties, is what we should be doing; although it is very valuable to explore new ideas and possibilities.

Teachers and educationists have an opportunity here, because the Government has introduced planning legislation which is based on public participation. I do not know what the situation is in

Hertfordshire; it is probably already operating on recommendations contained in the Skeffington Report for the preparation of local plans. The committee says that local groups or schools may be able to undertake some of the surveys. This is being done to a certain extent, and goes some way towards solving the problem.

It has been said that it was the schools who were responsible for the great swing from science towards social studies. I would challenge this and say that the cause is wider. Do not blame teachers in schools for having brainwashed the pupils to turn away from science. The general attitude probably starts in the home and amongst the youngsters themselves. The young are becoming concerned about the quality of the environment, finding their elders too much concerned with material things. I think people who grew up, formed homes and started a profession after the war found things much more difficult than today. Thus we grew into materialists. We have now reached a degree of affluence which we are handing on to youngsters, and they cannot understand our concern for the material things. The benefits are there for them to have, therefore they are turning to assess the quality of life. I want you to keep this in mind. We do not want to take this out of the youngsters in any course we set up, but to encourage it to grow.

Discussion

MR. SYKES: How far can you bring management processes into your field of study? Essentially, what the planner is concerned with is this, not just a study of the environment; and if you do this you are making up a much wider field of study. There would be considerable benefit, because school children would be aware of the particular social setting of their study. This would mean extending the course to explaining public administration, government, the law and that sort of thing. You would have to go into this in detail for children to be aware of how society works.

MR. FLADMARK: I do not think that our undergraduate schools in planning are necessarily concerned with entrants who have got a theoretical grounding in planning and management. If they had this,

they would not need to receive a further planning education. What I did try to say was that we would like students to come to us with a basic understanding of the interrelationship between the various science subjects. A unifying element is important, and I would support the idea of starting with the concept of energy flow systems, if we have to narrow our course down to one main concept. But I would also like to see the human element being introduced, to bring about an awareness of relationships. An understanding of the relationship between man and energy would make a good starting point in town planning education.

DR. BRACEY: The Skeffington Report would have been quite unnecessary if planners had done their job properly. They do not plan democratically and they do not make use of the public in the way they should. They may not be alone in this. The same argument applies to the administration of education, where too little use is made of parents. Even now the speaker is optimistic about the Skeffington Report, but I am terribly pessimistic. I had an experience recently where a voluntary organization had proposed to appoint a Countryside Officer to deal with, amongst other matters, relations between planners and the public; the answer from the county planning department was that they had already appointed such an officer. It seems to me that planners lack the human touch when they are actually planning in the field. Although, as the speaker said, the planner's job is to arbitrate, too often he seems to dictate. The more the study of human relations can feature in the proposed course, the better the planning we should get.

MR. FLADMARK: I would like to emphasize the point that even if the subject of environmental studies in sixth forms had just the one function of creating a greater awareness of the problems involved in maintaining our physical and social environment, it would be worth while. This function would provide a viable foundation for such a course.

MR. MELVILLE: How does this relate to environmental studies or something like it? We can look at a number of different alternatives. We can look at man's relationship to his physical environment or his relationship to his social or his economic environments, if you can distinguish them; but I thought we came here to define some syllabus for studying man in relation to his physical environment, his use of

physical resources, drawing in a study of man in relation to man only in so far as it related to the physical environment. We cannot go very far at all until we settle this point.

MR. GWILLIAM: We ought to spend a great deal more time in schools on aesthetics and ethics, and on dramatic work, in which pupils understand other people's experiences. They need to know firstly how to study, and then how to relate other studies in general to what is 'good' in platonic terms.

MR. MELVILLE: The question still remains: do we try and focus on the social responsibility of man in his physical environment, or of man to man, the interpersonal relationships. These are significantly different things.

MR. FLADMARK: These are two different aspects which might be worth developing in parallel, to see whether they can be brought together or whether they must remain separate for educational purposes.

MR. OSWALD: The problem is that they have been treated as two different things and as the fields of two different groups of people.

MR. TILLOTT: If you are considering the relationship of man to his physical environment, this includes housing; but it depends on the relationship of man to man. How can it be an affluent society which has three million houses without lavatories? This is a man to man relationship, not a relationship between man and his environment. Should our course bring this out?

MR. FLADMARK: My reaction to the general drift of the discussion at this stage is that we must separate the two issues if we are to succeed in establishing any guiding principles for the syllabus of environmental studies. I suggest we do not stray too far away from our theme of man and his relationship with the physical environment. The 'man to man' issue should be treated separately, and this may indicate that there is need for another new subject, which could be labelled 'social awareness'. If we accept this, we may have overcome a basic difficulty in defining elements of the boundaries of a suitable 'A' level course. In turn, we may also be able to accept the 'man/energy' relationship as common ground for further deliberations.

MR. TILLOTT: The whole question of where biology is going, and the social implications of biological research or nuclear research, seems to fall into the same category. I think perhaps it might be a more general issue than just one of environmental studies. To emphasize this, perhaps it is necessary to have an 'A' level. Awareness of the social consequences of scientific development, and of the social issues involved, and the control which is required, should go hand-in-hand with all scientific subjects.

DR. ROBINS: Some people may feel, as I do, that the rather more detailed points made would be better kept for small group meetings. Here we should be concerned about the general intention of the course in environmental studies or science. From the angle of those planning training in the universities and polytechnics, what worries us is that people may feel that there is some magic in having a package of facts that they have learned before they came to us. The trouble is, they have learned a few facts, but nothing about how and why things happen. Environmental science needs a great deal more study of economic influence, social influence and aesthetic influence. Look at the history of planning courses that the Town Planning Institute requires. We regard the history of planning as the story of the liberation of man from the physical restrictions of the natural environment.

MR. PRITCHARD: We have been talking a great deal about analyses. We have been talking about the content of the 'A' level syllabuses and the limitations of the new syllabuses for a new subject. We have also looked at a method whereby these can be defined. There are other ways of examining a course, for example in terms of educational research. I have written down the main topics of Bloom's Taxonomy,[1] and it is interesting to see how we could use them here. A course could be developed that included interpretation, summaries, extrapolation, analysis, application, analysis of limitations, analysis of relationships and analysis of organization principles in the cognitive domain. You can develop these in such a way that a person's value judgements are built up. Certainly we range widely here. I wonder whether there is a range over which we can go too far in

[1] BLOOM, B.S., et al (1956) Taxonomy of Educational Objectives: The Classification of Educational Goals. Handbook 1: Cognitive Domain. London: Longmans.

expecting a sixth-former to develop? Is it possible to analyse the course in these terms? Consider the question of whether a democratic planning environment is of importance. We could get all school pupils, particularly sixth-formers, to look at their environment, urban or countryside, in terms of their own responsibility.

MR. GWILLIAM: A new sort of sixth-former exists who is now attempting 'A' levels for the first time. If we consider a particular subject, we get a fairly good understanding of the limitations that the examiners and universities are looking for. Some ideas which we have proposed could be so fragmentary for a teacher planning a course with sixth-formers as to make it very difficult for this new type of sixth-former to get to grips with what the subject is all about.

PROF. FISHER: There is quite a lot in that. I receive about 110 sixth-formers every year. Topics sometimes come up which are completely outside their area, for example Vietnam or the French Revolution. Some would claim never to have touched these. I am in favour of a certain amount of selection in a sixth-form course rather than providing a course of which they have only a superficial knowledge.

MR. MELVILLE: Generalizations are not necessarily superficial. All our scientific laws and so forth are generalizations. We have to generalize, to order the chaos of experience, to understand things.

PROF. NEWBOULD: I am rather concerned about the boundaries between the scientific study of the environment and its interpretation, and the use that is made of this in management and so on. In planning processes, at present, these boundaries are not sufficiently clear, and management strategies get confused with a situation which ought to be established independently.

MRS. SHAW: The themes that have been mentioned are discussed in a disciplinary way in general studies. Sixth forms all have time on non-examined subjects. These appear to be excellent themes to develop in a non-examinable way. I would be sorry to see interesting themes confined to the subject of environmental studies just for children who have chosen that subject. They are excellent topics for discussion in sixth forms generally.

MR. GWILLIAM: Some of us are more interested in specific issues,

discussing the particular economic area, sizes of population and so on, which are only part of the syllabus.

MR. HAYWARD: I have some anxiety about the environmental studies course proposed, on the grounds that we are really trying to do too much. It is most important that we should consider technology in such a course, and particularly the effect of advancement of technology on the future of man. This has already been mentioned by a previous speaker in connection with building and planning. I believe that technology must come into this course somewhere. I am afraid that I am wanting to add something and bring in more than has been mentioned. Yet at the same time I feel we have such a broad syllabus that we must try to make it more concise and quite different from the general studies course which we are providing in our sixth forms. Such courses should form a vital part of liberal studies.

DR. HEALEY: When I come into contact with sixth-form teachers I am struck by the enormous diversity of their interests. Some are interested in science. Others have perhaps more interest in social problems, and can investigate these. We must leave options for people to specialize in.

MR. TILLOTT: Is general studies not an examinable subject?

MR. GWILLIAM: Yes, it is.

MR. NEAL: The Schools Council's position in regard to examinations is that it does not promote or develop 'A' level examination syllabuses as such. It is concerned with the broad issues of examinations and, with regard to the development of 'A' level courses, acts as a central reference point, approving or disapproving syllabuses following their development by schools and colleges and submission by the GCE examining boards. The Council is concerned with the maintenance of nationally accepted standards.

DR. KITCHING: Listening to what teachers have to say about schools' work in this context, it seems to me that schools would benefit a great deal by using the resources of the local environment in teaching at this level. Would such approaches raise difficulties as far as the examining boards are concerned?

MR. NEAL: Not necessarily. Not unacceptable difficulties.

MR. OSWALD: How do the Schools Council curriculum projects fit in with the policy of the Council in examinations? As far as I can see, the Schools Council is promoting new ideas through its projects while taking rather a back seat position as far as examinations are concerned.

MR. NEAL: Our psychology on the curriculum development studies is to provide as many opportunities to teachers as they may wish to take up. There are two problems to look at. We act as a central reference point for existing examinations but we necessarily have to be a servant of teachers as well, by stimulating curricular reform which may lead to the development of new examination syllabuses.

PROF. NEWBOULD: How far would the extensive examination of projec work, as in Nuffield Science, with greater involvement of teachers in examining their own pupils, prove a difficulty?

MR. NEAL: This is going well but leads to problems. If you get a large sixth form and have projects in chemistry and physics, the examining load on schools, although heavy, can be managed, with the help of moderators. If this method of examination develops on a wider scale, schools and boards will be faced with tremendous difficulties in terms of the load on teachers and expense.

MR. PRITCHARD: In the first instance, a project was considered as work to be done over and above the time we spent in the classroom. Now this has been reduced and an alternative produced. But what concerns me in this direction is that there seems to be little research on the value of doing a piece of project work. What areas of learning do you hope a student to develop by an individual piece of written work or of fieldwork? I would like to see research done on this.

MRS. SHAW: Projects in sixth-form work are increasing. Engineering project work counts for one-third of the total marks, and shows a different facet of the student's ability. This has to be marked by a visiting examiner, which is a more costly examination method. We are prepared to do this in engineering because it is essential, but the public must know that it is very expensive. 'A' level is vital and correlation is critical. Our board does not think we can award a certificate in which one-third of the marks have been assessed by the teacher.

MR. GWILLIAM: This will have to come about. The boards will have to recognize that teachers should be capable of the necessary level of assessment.

MR. CARSON: May I point out that in universities you tolerate largely internally assessed examinations, and award degrees on this basis? The time must soon come when the same reliance is placed on teachers.

MR. GWILLIAM: Demanding more of teachers would still leave control through moderation.

PROF. HUNTER: I do not know if the discussion is going on in the way Mr. Carson forecast. It seems to me that we are expected presently to break up into groups and to do some work. We are expected to draw up some kind of syllabus for a course or courses which we have not yet defined, on a subject about which nobody in this room seems to agree, either about its boundaries or the meaning of the title. From the point of view of the physical environment, man is relatively unimportant. The physical environment has been evolving for 10^{10} years, and our influence on it has only been effective in the last 100 years, and then only on one planet in the universe. Man, therefore, is really comparatively unimportant. On the other hand, I can see there is a strong case for something which is getting rather near human geography on the planning side or on the sociological side, which seems to be supported by some. We must decide whether we are aiming in the schools at a syllabus to satisfy university entrance requirements or one justified on educational grounds. Although a course aimed mainly at educational value may be highly desirable, there is a danger of environmental sciences being put in a similar category as general studies. University selection committees may be reluctant to accept it in assessing a student's ability for a university place. Secondly, we must decide whether we are going to be more concerned with the physical environment or the human social environment before we can get any nearer to solving the problem.

MR. CARSON: I do not think that it is my place to give answers to these questions before you break into study groups. The chairmen of the groups will bring you up against the hard facts, and I drew your attention to the necessity for establishing boundaries early in the conference.

Chapter Five: Study Group Reports

1. A Sociological Approach

R. C. Gwilliam, Chairman

OUR discussion centred on the urban environment including the impact of urban society on the countryside; and on town and country planning needs.

The very first question we considered - 'Who wants a new 'A' level; the schools, the universities, the pupils?' - was never answered, but during the course of discussion it became clear that becoming 'child centred' was not easy for the sort of adults collected together here. We did agree, however, to consider it useful to go on trying to create an 'A' level environmental studies. Some other things were agreed and gained general support. For example:

1. that there would be no 'prerequisites' (previous particular 'O' levels, etc.) for taking 'A' level environmental studies;

2. that, equally, there would be no limitations such as simultaneous study of other 'A' or 'O' levels; although, obviously, anyone seeking to use such an 'A' level in conjunction with others of similar areas of study, such as geography or economics, would be assessed accordingly by a university;

3. that attempts to limit the areas of detailed study, for example by putting emphasis on Great Britain, or on 'the countryside' were not acceptable, although emphasis would remain on including areas of direct observation;

4. that there could properly be certain aspects of a syllabus which were essential, and among these were:

(a) an understanding of basic ecological patterns, together with man's management of this ecology;

(b) an understanding of social organization;

A MAN CENTRED COURSE

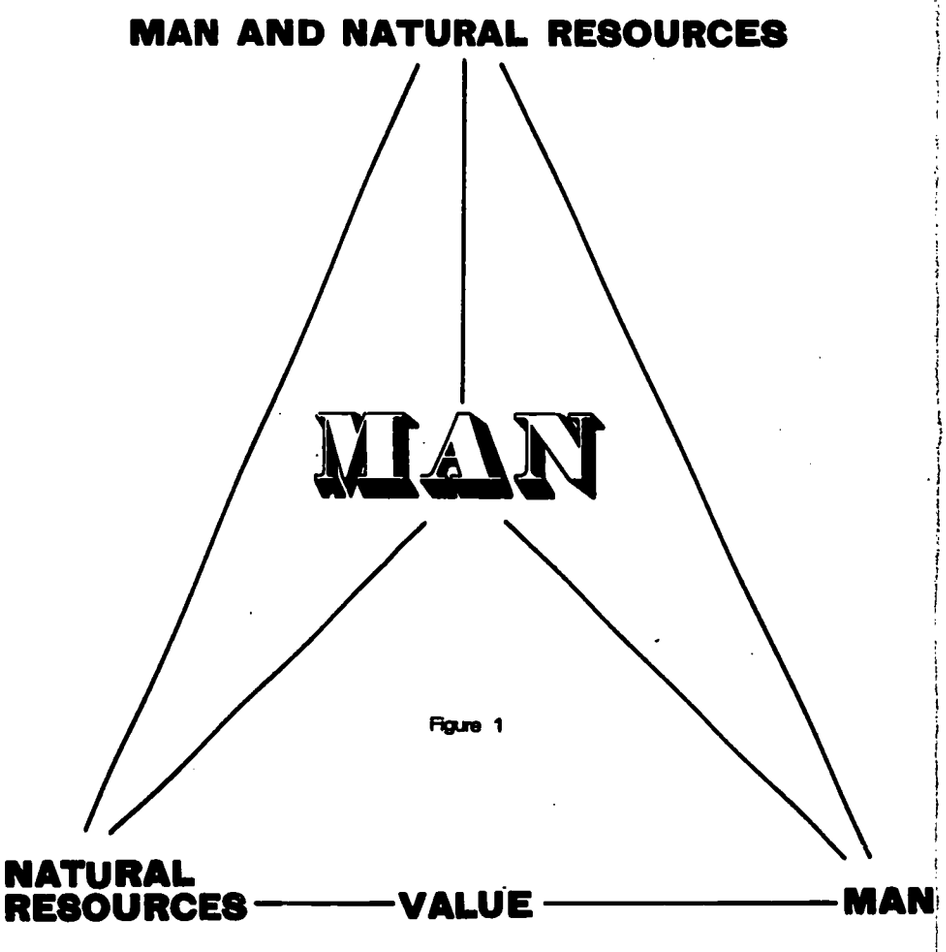


Figure 1

(c) an understanding of methodology and 'predictability';

two interesting statements which emerged at this point were that the subject under discussion could be described as 'applied economics with a dash of social content'; and that 'pupils would benefit if they played Monopoly realistically';

5. that in the examining of this subject, written and oral, much weight (towards 50 per cent should be given to individual topic studies, whose conclusions, rather than the facts collected, would be of major interest; and that selectivity and ability to report would also be major criteria of value. There was hope that a 'Mode 3' situation would develop in relation to the examinations.

Most important of all, however, this group put two points forward for general consideration: that the course should be 'Man'-centred; and that it should be 'systematic' in emphasis, not rigid in its factual content, allowing optional aspects as examples of the system under review.

These two approaches are represented respectively in Figures 1 and 2.

2. *A Biological Approach*

E.J. Douglas, Chairman

THE BRIEF was to produce an 'A' level syllabus from a biological approach, emphasizing the rural environment, including the impact of the development of agriculture, forestry and horticulture.

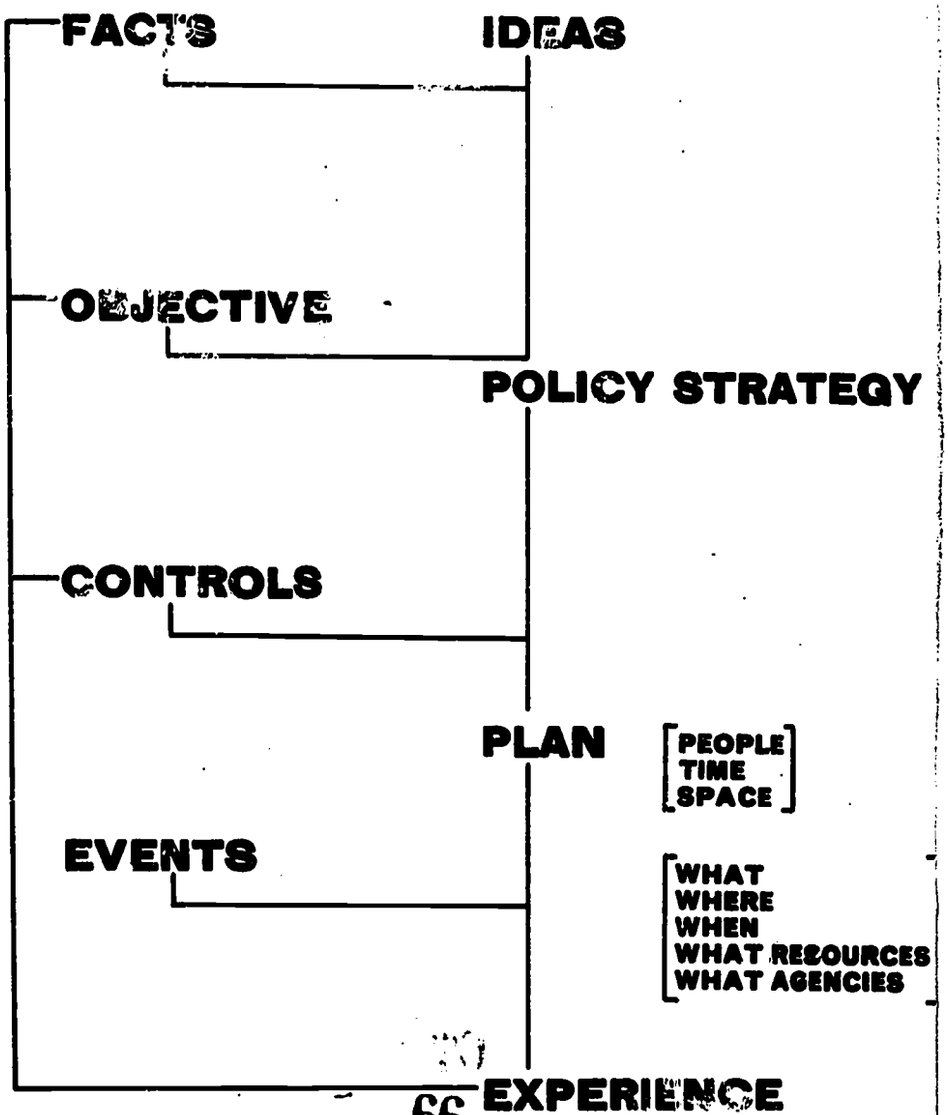
The short time available precluded consideration of the right depth in any area, but the morning group agreed on the general outline of the syllabus, which had as its main theme 'the concept of energy'. Figure 3 indicates the major sections of such a syllabus. We deliberately maintained flexibility to allow co-ordination with the contributions of other groups.

The afternoon group had an almost entirely different composition and disagreed with the concept of energy as the main theme. They proposed 'land use'. The very brief outline of a syllabus on these lines is as follows:

(a) processes and systems of the natural environment, and the limits of the resources base;

B SYSTEMATIC APPROACH

Figure 2



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(b) processes and systems of land use and their interaction with the natural environment;

(c) evolution. Existing state and predictable future of population, activities and organisations in relation to resources capacity.

The afternoon group expressed the opinion that the proposed syllabus based on land use did not differ from a modern geography syllabus and could be taught by a competent geographer. The chairman was of the opinion that the syllabus based on the concept of energy could well be taught by a competent biologist. It was, however, generally agreed that the teaching of such a syllabus would be done in practice by a team.

It is difficult to see why the original Hertfordshire 'A' level syllabus for environmental studies has not been accepted. There is perhaps room for slight changes of emphasis, but its academic content is at least equal to that of any existing syllabus in other subjects. It is agreed that there is a need for such a syllabus, which should be acceptable by university departments.

Although the original 'A' level syllabuses in environmental studies have been turned down, it is generally agreed that there is such a subject in its own right. There is plenty of material, ideas and content in the original syllabus. A new syllabus should perhaps be submitted through the Schools Council, and would then, hopefully, be accepted by examining boards, whose task it would then be to produce an examination technique for it. An outline of such a syllabus, based on the concept of energy, is shown in Figure 3.

3. World Conservation Problems: Population, Natural Resources, Pollution

H.A. Smith, Chairman

MORE THAN one member of the conference must have wondered why four Hertfordshire headmasters were chosen to chair the discussion groups. The explanation that headmasters are used to keeping groups in order, and therefore might be able to present a coherent account of two and a half hours discussion, is immediately seen to be a fraud in the lines that follow.

I admit from the outset not only that I have no guide-lines for

a syllabus to offer, but that we did not discuss the given topic at any stage. Members obstinately insisted that far more fundamental questions had to be answered before you could get down to an actual syllabus.

Figure 4 is the outline of an area of study which remains to be specified in strict syllabus terms - but while it was, broadly speaking, accepted by the morning group as a reasonable basis to work on, it was questioned by the new members who joined us after lunch, both in terms of its logical progression and of its overlap with other disciplines, notably human geography.

The chief claim we would make as to any special merit in this scheme is that it considers man as a psychological being. This has two advantages: firstly, that it covers an area which is not covered by any other subject; secondly, that the British Psychological Society, among other bodies, supports the introduction of psychology as an 'A' level study.

The aim behind the whole scheme is to emphasize man, and the hierarchy of satisfactions that he needs, as the unifying theme of the syllabus. This is at least one way of avoiding the dismissal of the syllabus as nothing but a collection of bits and pieces from biology, geography or other existing subjects.

We agreed at the outset to ignore the question of qualifying factors limiting admission to an 'A' level course; indeed, some hoped that no barrier at all would be placed in the way, on the grounds that such a new syllabus might provide a means of involving boys and girls who would have thought themselves incapable of such studies under their traditional names.

Figure 4 is in no sense a finished document. It was only used as the basis for disoussion and was criticised from several points of view. We had no time either to consider the weighting of the items listed (they all appear equal here, but almost certainly are not); nor to specify the depth of study necessary on any given point to make it an acceptable qualification at university level.

One member did offer a four point break-down of the physical environment in terms of the structure of the earth; the planetary atmosphere; the sun and its radiations; and the interactions of boundaries - the hydrological cycle.

We turned our attention, finally, to the question of whether universities would accept an 'A' level syllabus based on such an approach. On the whole, it was felt that they might, though it was

SYLLABUS OUTLINE BASED ON CONCEPT OF ENERGY

Figure 3

MAN AND HIS PHYSIOLOGY

MAN'S PRODUCTIVE SYSTEMS

SOLAR RADIATION
PHOTOSYNTHESIS
HYDROLOGICAL
FOSSIL FUELS
AGRICULTURE
FORESTRY
ANIMAL HUSBANDRY

MAN'S MANIPULATIONS AND NATURAL RESPONSES

OBJECTIVES OF METHODS-POSSIBLE ENDS
ORGANISATION OF HUMAN SOCIETIES
TO GAIN OBJECTIVES-NATURE
OF CHANGE-LEGISLATION
EFFECTS-POLLUTION-EXHAUSTION
RESOURCES-CONSERVATION

PRODUCTION SYSTEMS

INJECTION OF KNOW-HOW
NON-PRODUCTIVE OBJECTIVES
RECREATION-CONSERVATION
INDUSTRIAL PROCESSES

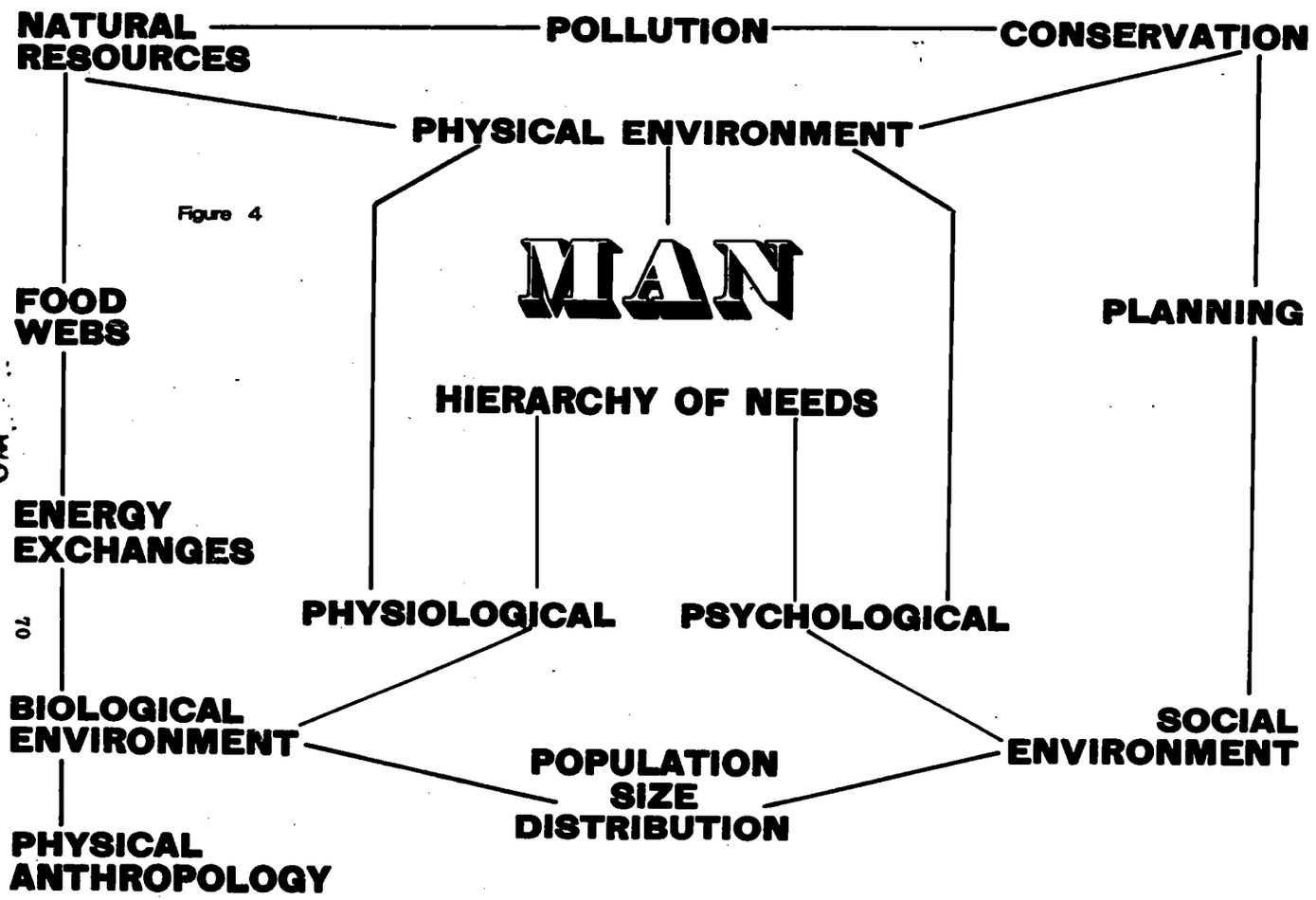
NATURAL RESOURCES
POLLUTION
CONSERVATION
PHYSICAL ENVIRONMENT
MAN
FOOD WEBS
PLANNING
HIERARCHY OF NEEDS
ENERGY EXCHANGES
PHYSIOLOGICAL
PSYCHOLOGICAL
BIOLOGICAL ENVIRONMENT
SOCIAL ENVIRONMENT
POPULATION SIZE DISTRIBUTION
PHYSICAL ANTHROPOLOGY

Figure 4

likely that few faculties would accept either geography or biology 'A' level along with this as a separate subject.

Regarding methods of examining such a syllabus, emphasis was placed on the need for full intellectual abstractions about the subject on a world scale; it should not be restricted to local studies. The difficulty of making valid assessments of projects was recognized. But it was agreed that, if there were difficulties, co-operation between the universities and the schools both in terms of teaching and teaching materials, could get the subject off the ground, as Loughborough had already proved.

4. Man and his Environment

A.H. Hayward, Chairman

THIS STUDY group was concerned with finding a definition of the concepts essential to a study of the interaction of man and his environment, urban or rural, local or world wide.

The chairman opened the discussion by suggesting that the group should think along the lines of energy flow, bringing in human problems when possible. If much sociology was brought in, there might well be too much material for a single syllabus. He felt that the course should be basically a scientific study.

One member of the group suggested that the energy concept was right for environmental science but not for environmental studies. He wanted to focus on the study of land use and so forth, as it related to the social, economic and natural environment. It was suggested that there was a need for two separate syllabuses, but this was not generally agreed. Another member thought that the relationship of man to his environment was not necessarily a scientific subject: the concept was a sociological one.

It was then agreed that man in his present environment should provide a starting point. It was suggested that we should employ a systems approach - a succession of processes representing the effect on man of his immediate locality, the country as a whole and the world at large. This idea of human systems seemed to be preferred to the idea of land use as a basis for a syllabus. One group member thought that at least two-thirds of the syllabus should involve a scientific study, only one-third of it being concentrated on the human aspect. The general systems theory would provide a link with

Figure 5

PHYSICAL SYSTEMS
ENERGY FLOWS

1 PHYSIOLOGICAL

2 SOLAR

3 AIR MASSES
(WEATHER)

4 WATER MASSES
(OCEANOGRAPHY)

5 LAND MASSES
(GEOLOGY)

6 ECOLOGY

7 ECO-SYSTEMS

8 NATURAL RESOURCES

HUMAN MANAGEMENT SYSTEMS
MANIPULATIVE PROCESSES

1 PRODUCTIVE
- AGRICULTURE
- FORESTRY
- POPULATION
- PLANNING

2 NON-PRODUCTIVE
- RECREATION
- CONSERVATION

3 TECHNOLOGICAL
- INDUSTRY
- POLLUTION
- NOISE
- COMMUNICATIONS

PROJECT
- INDUSTRY
- FARM
- URBAN
- VILLAGE
- CONSERVATION

ecology, and he felt that it would help the rigour of the course if some mathematics concepts were required, for example the set system; and perhaps some statistics could be usefully brought in. The Hertfordshire syllabus already involved a general systems approach, which allowed some descriptive elements and some analysis and also a management element. It was felt that there should be two sections to the syllabus:

1. Scientific systems (physical/biological) providing a study of natural resources and other systems in nature.

2. Human management systems, involving manipulation processes.

It was felt that the 'A' level course should have some optional sections. An examination paper might have three sections, geographical, biological and sociological in make up. But it was difficult to expect teachers to be able to teach such a broad syllabus. Some team-teaching would help. A danger in the Hertfordshire syllabus was that it was too locally biased. Students should be able to deal with situations they may not have experienced at first hand. A start should be made on a local basis, leading on to an appreciation of more general problems. The syllabus should certainly involve a project. The planning and conservation aspects should be considered early in the syllabus, but conservation alone was not sufficiently definitive for the main theme.

In the afternoon, the group agreed that the course should follow two parallel themes. These are represented in Figure 5.

It was pointed out that, before we could go any further with a more detailed syllabus, we must decide our aims and objectives. How far were ethical aspects to be considered? The chairman felt that the aims as laid down in the Hertfordshire syllabus were adequate. As far as the ethical aspects were concerned, he thought it was our job to help sixth-formers to think for themselves. When there were two sides to a question, the teachers must indicate both, and allow the students to weigh up the pros and cons and come to their own conclusions. Another member said that the universities were concerned with content and not with aims. He felt that the suggested course was a great improvement on the present 'A' level geography courses, particularly as far as continued study of environmental subjects was concerned. He would rather see a limit in the areas of study than in the ideas involved. Food and technology were mentioned as two

topics whose energy flow could be followed through from man's local environment to provision on a world scale. The effects of world production could then be traced back to man himself. Another theme suggested was that of recreation. It was pointed out that there would be many examples of controlled environment, such as farms, forestry, new towns and recreation facilities, in the immediate neighbourhood of schools. The need for an environmental science paper had arisen because other disciplines had failed to provide the necessary breadth. The fact that there was some overlap with biology and geography was not thought to matter.

Final Discussion

MR. NEAL: In the development of any new subject, the Schools Council will often want to see evidence of the work done before a syllabus is generally made available to schools. Developing a syllabus in a new subject can take two to two and a half years of consultation. As far as the Council is concerned, I hope that a syllabus is developed from the schools in conjunction with the boards.

MR. BROAD: For five years we have been trying to get this one off the ground. I hope it is not going to take another two and a half years.

MR. MELVILLE: What is going to happen when we leave here?

MR. LUCIA: We have had a syllabus put forward to us, as you know, for environmental studies, and have approved it at 'O(A)' level. I think, however, that we must look carefully at some of the reasons for examining environmental studies. I did not find impressive arguments that, say, history and mathematics are available at both 'A' and 'O' levels. These are subjects which are taught in infant, primary and secondary schools, and they take on very different aspects in these different areas. I think I am right in saying that the problem is one of definition. This conference must ask itself the question: What is it that we see as fundamentally an 'A' level discipline, and does the subject environmental studies satisfy our criteria? I understand that the London, Oxford, Northern Joint Matriculation and Cambridge Boards have 'O' level syllabuses either for general use or as special papers. Our problem here is with the paper of an 'A' level syllabus. The chairman of one of the four groups mentioned a suggestion that an 'A' level syllabus in this sub-

ject should be two-thirds science. Is this generally acceptable? We shall not be able to decide whether environmental studies is appropriate for 'A' level examining until we have sorted out our aims and objectives and decided what part of the sixth form is likely to be involved and why they want this particular examination.

MR. BROAD: Let us recall some of the explanations earlier in the conference. The way in which we started off was to say that none of the company here was unaware of the need for conservation. We accepted that, as a nation, a mass of the people who are in positions of authority are superbly ignorant in these fields, yet wielding enormous power. We thought that it would be a good idea that they should not be so ignorant, and that those who were going out from our schools and universities should not be left without any knowledge of the problem of environmental control. We realized also that a supply of teachers, either from universities or colleges of education, who were basically knowledgeable in these matters was essential.

Everybody here accepts the need for the 'A' level course, without which we cannot begin to deal with the problems. If Britain is not able to deal with the problem, what other country can? It is urgent that something should be done. We ought not to be choking over gnats.

Every paper that has come up has assumed, without question, that there should be a course of some kind in this field. We need not now go over the ground again as to what a syllabus should cover. We have, at least, a pretty good idea of all the things that the different study groups had in mind, and the charts which they devised will certainly be helpful.

Can we reach any common ground? Listening to, and reading, your comments, I think that there <u>is</u> a field of agreement; and from this it should surely be possible to draw the outline of common ground, and eventually to draw up a syllabus.

A working party of specialist teachers was convened in Hertford in December, 1970, to prepare an 'A' level syllabus, based on the views of the conference, for submission to a number of examination boards in the hope that they would adopt it and thus make it possible for schools everywhere to devote sixth-form time and teaching to environmental studies. The syllabus, with related teaching notes, criteria for examination, specimen papers and details of available teaching resources, occupies the rest of this book.

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'A' Level Environmental Studies: The Syllabus and Teaching Notes

Introduction

1. A working party of Hertfordshire teachers has been engaged in producing this syllabus for almost a year.

The need for such a course in sixth forms has arisen as a result of the development of CSE 'O' level and 'O(A)' level courses in Environmental Studies and as a reflection of the concern for the environment and its conservation that has developed in the last few years.

2. An 'A' level syllabus has to fulfil a number of clear functions and the working party have had these in mind throughout –

2.1. Firstly the examination must be recognized by a number of university faculties as a qualification for entry.

2.2. Secondly universities generally must recognize the course as a discipline of sufficient rigour to indicate the intellectual quality of the successful candidate.

The working party are confident that these requirements have been met as a result of the involvement of some fifty senior university professors and lecturers in a preparatory conference at Offley Place in October 1970 and in subsequent help in the construction of the syllabus.

2.3. Thirdly an 'A' level pass must offer career opportunities at non-graduate level. Colleges of education and professional bodies concerned with the land-linked professions and with Town and Country Planning have indicated sufficient interest for the working party to feel confident that this course will open doors into such careers or colleges.

2.4. Fourthly an 'A' level syllabus must offer a course that is relevant to modern needs, educationally worthwhile and which has a logical unity of purpose. In this respect the syllabus sets out to explain the ecological inter-relatedness of the environment, the place of Man, to study the impact of human society on the environment and the possibilities of management and control.

2.5. Fifthly the introduction of a new course at this level must offer new educational methods (which will involve students deeply) and new examination methods which will assess achievements in these activities if it is to justify its inclusion as distinct from (and not instead of) traditional subjects.

The working party have approached the subject after some study, with the conviction that such a course should involve students in a great deal of first hand investigation in facing open-ended problems to which there are no clear right or wrong answers, and in looking at real life situations in which problems do not always lie within any particular specialist disciplines.

2.6. Finally the course has to be a practical possibility in schools. The working party do not take the view that only a specialist can teach each separate discipline constituent with such a course. Experience in developing sixth forms in Hertfordshire all-ability schools has shown that we have plenty of teachers capable of teaching successfully to 'A' level in a range of subjects in which they themselves were not specialists. The syllabus is designed and teaching notes have been drawn up to fit a situation where the course is taken by a single teacher (8 periods a week) or by two teachers (4 periods a week each).

Obviously there will be areas of the syllabus in which such teachers (rural or environmental studies, geography, biology or science probably) will want help. For this reason a three-week full-time session of the working party is planned in June to gather resource material to extend the teaching notes. Interested

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teachers will be invited to see books and other material and a detailed list will be circulated. Further courses at sufficient depth for teachers, covering the background to different parts of the syllabus, will be held as soon as the demand is clear.

2.7. Other Syllabuses in Environmental Studies might well be designed. The working party are conscious that the breadth of this area of study is such that they have had to omit many considerations of importance. In particular they deliberately did not include sociological studies, psychological or physiological factors that might be involved in Social Studies or in Ergonomics. They accept the probability that other syllabuses in these areas may eventually arise.

2.8. Objectives. In addition to fulfilling the criteria outlined above a course must be designed with certain clear educational aims in view. The working party accepted the definition of Environmental Education of the International Working Meeting on Environmental Education in the School Curriculum, (International Union for the Conservation of Nature and Natural Resources, September 1970) as follows:

'Environmental education is the process of recognizing values and clarifying concepts in order to develop skills and attitudes necessary to understand and appreciate the inter-relatedness among man, his culture and his biophysical surroundings.

Environmental education also entails practice in decision-making and self-formulating of a code of behaviour about issues concerning environmental quality.'

From this arose the educational objectives agreed:

a) To make clear the concept of the ecological interrelationship of the physical and biological factors that make up the environment.

b) : To develop skills and attitudes necessary to appreciate the place of Man in the environment and the impact of human society on his biophysical surroundings.

c) To study the ways in which Man may control his environmental impact and to recognize the values by which such control may be guided.

The working party felt that these objectives would be better advanced by placing the student in a situation of personal involvement, and contributing to his own studies as far as possible through extensive activities in the field and laboratory rather than by too much authoritative teaching.

2.9. For this reason examination methods are suggested that will not rely too heavily on recall; at the same time the limitations of present examination procedures in relation to field work have been borne in mind (see pages 37-38).

2.10. Members of the Working Party are listed on page 39.

2.11 The Working Party wish to express their thanks to Mr. S.T. Broad, County Education Officer for his continued support, and wish to thank Dr. J.J. Grant, Director of the University of Durham, Institute of Education, and through him the University of Durham for making it possible for Dr. J. Kitching to assist myself with the project.

S. McB. Carson
County Adviser for Environmental Studies

31.3.71

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Content of the Syllabus

Section One: Processes and Systems of the Natural Environment and the Limits of the Resources Base

1.1. THE SOLAR SYSTEM

Brief outline - sun, moon, earth.
Revolution, rotation, orbits, gravity.

1.1.1. Sun as a Source of Energy

Nature, size and distance, temperature, effect on climate.
The nature of fission and fusion.
The laws of thermodynamics.

Teaching Notes

Section One: Processes and Systems of the Natural Environment and the Limits of the Resources Base

Teaching time suggested: 100 hours. (Detailed time break-downs are given throughout as a guide).

The aim here should be to give background information about the primary source of heat energy in the solar system and about how that energy reaches the earth.

1.1. THE SOLAR SYSTEM (15 hours)

Indication of the scale of earth - moon - sun system (other planets ignored). Although moon and earth have same angular diameter, sun is 400 times further away, c.f. 8 mins. for sun's light to reach earth, 1.2 secs. for radio waves from moon.

Diameter ratio approx. the same; c.f. total solar eclipse.

Geometry. Inclination of earth's axis to the ecliptic.
Elliptic orbit of earth (not significant).
Gravity. Cause of circular (or elliptic) orbits.
Cause of pressure inside celestial bodies. Very great with sun.

Gravitational force proportional to mass of body and inversely proportional to distance squared.
Cause of tides - tidal energy.

1.1.1. Sun as a Source of Energy

Energy - various forms of energy, e.g. heat, chemical (fuels), nuclear, gravitational (hydro electric, tidal) kinetic, etc.

Conservation of energy. Energy cannot be created or destroyed (except in a nuclear process). It can only be transferred, and then only from a hotter to a cooler body, unless external energy is used as in the refrigerator, or in living material.

1.1.2. <u>The Transport of Energy</u>

The properties of radiation .
Wave radiation of energy.
Reflection, refraction, absorption, total energy.

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1.1.2. The Transport of Energy

Wave nature of radiation - electromagnetic spectrum chart. Illustration of properties at various lengths: 30 mm wave apparatus, light, heat, detected by photo transistor.

Reflection - reflection coefficient - Albedo
typical values for cloud, land, snow, etc.

Absorption. General: fraction transmitted proportional to thickness. Line absorption: particular wavelengths absorbed by particular substances (c.f. Fraunhoffer lines in solar spectrum) when cooler than source, by elements (in outer layers of sun) and by molecules, particularly CO_2, H_2O, O, O_2, O_3, in the atmosphere (see above).

Refraction - demonstrated with light, small effects at time of apparent sunrise and sunset.

Total Energy radiated is proportional to (absolute temperature) ^{4} (Stefan's law) hence

$$\frac{\text{Energy radiated from SUN}}{\text{Energy radiated from EARTH}} = \left(\frac{6000}{300}\right) 4 = 160000$$

Inverse square law

Energy distribution depends on temperature (see diagram below). Energy re-radiated from Earth at long wavelengths and is trapped by CO_2 and H_2O in atmosphere (greenhouse effect).

More generally, a system left to itself will become more and more disordered, or chaotic, and energy will end up uniformly distributed. ENTROPY is a measure of disorder and in any energy transfer will tend to increase. (No deeper treatment of thermodynamics should be necessary).
Factual information about the sun.
Fluid, indicated by passage of sunspots observed by projecting image with long focus lens on card.
Centre at enormous pressure. All material stripped of electrons therefore only nuclei left.

1.2. THE ATMOSPHERE AND HYDROSPHERE

1.2.1. Atmospheric layers and filtering effects

Ionosphere - presence of Van Allen belt
Troposphere - presence, physical and chemical composition, insolation, tropopause.

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Amount of energy flow from sun too great for chemical reaction. Therefore Einstein explanation.
Energy and mass are interchangeable.
$E = MC^2$

Nuclei of atoms range in mass from 1 atomic unit to 200 or so from Hydrogen to Uranium and beyond.
They are made up of protons and neutrons.
Elements at either end of the scale contain more energy than ones in the middle - and therefore weigh more than their constituent parts. The extra mass being that of the energy according to equation above.
Energy can be released (and mass destroyed) by
(a) breaking or splitting a large (e.g. Uranium, Plutonium) atom into two medium sized ones - FISSION;
(b) fixing together two small (e.g. Hydrogen) atoms to form a larger one - FUSION.
The latter process takes place only at high temperatures (several million degrees) and high pressures. These exist in the sun due to size and gravity. Ref. to ZETA (Zero Energy Thermonuclear Apparatus) and to Hydrogen Bomb.

By-product of such processes, atomic particle showers. Travel to earth in a few hours or days. Produced during 'magnetic storms' associated with sunspots. Affects radio communication, Aurora, Ozone (O_3) levels in upper atmosphere. Is there evidence for relation between sunspot cycle (11 years) and climate. Investigation.

1.2. THE ATMOSPHERE AND HYDROSPHERE (40 hours)

1.2.1. Atmospheric layers and filtering effects

The shielding effects of the Ozonosphere should be mentioned. Atmospheric pollution can be measured and its possible effects could be discussed here.
Oxygen and pressure levels and their influence on human physiology, linking with 2.4.

The chemical erosion of buildings, linking with 1.3., can often be seen. Direct observation can be encouraged. Some understanding of chemical changes will be necessary. The controversy about the effects on the upper atmosphere of supersonic transport can be discussed.

1.2.2. Insolation

Definition, seasonal and diurnal variations over the world, temperature variations.
Principles of the solar energy circulation between the earth and the atmosphere.

1.2.3. Weather systems, air masses and climate

Evaporation, humidity, condensation, super saturation, precipitation, air stability and instability.
The general circulation of the atmosphere. Pressure systems, winds, depressions and anticyclones; location, occurrence, formation.
Recognition of main climatic regions.

1.2.4. Water cycle

Distribution and redistribution of the world's water.

1.3. THE LITHOSPHERE

Earth structure, internal energy flow and its relation to continental drift, earthquakes, vulcanicity, folding, mountain building.
Formation of igneous sedimentary and metamorphic rocks, mineral resources.
Appreciation of geological time scale.
Weathering processes leading to soil formation.
Land forms - aspect, drainage and slopes as features of land surfaces and soils, classification of soil types.
Concept of the limitation of resources.

1.2.2. Insolation

1.2.3. Weather systems, air masses and climate

The basis of this section should be practical observation, measurement and recording of local conditions and then relating this to the broader picture.
Climate reliability should be considered. Climate graphs can be used to give a brief picture of the major climatic types, e.g. Equatorial, Monsoonal, Mediterranean, Polar Continental, etc. BUT it should be pointed out that figures can be misleading. Reliability of rainfall and effectiveness of the rainfall are of vital consideration in many parts of the world. The tremendous forces involved in weather phenomena may be discussed in terms of energy.

1.2.4. Water cycle

1.3. THE LITHOSPHERE (20 hours)

The formation of rocks should be related to the energy content of the environment in which they were formed, e.g. high energy environment, igneous and metamorphic rocks, conglomerate - low energy environment, silts etc.

The Plate Theory of continental drift is a useful starting point, in that the movement is linked with the up welling of magma along the plate joints, e.g. the mid-Atlantic ridge, and this in turn leads to a study of volcanoes.
Crustal deformation ... folding and faulting should be considered especially in respect of the way in which they affect the position of towns, e.g. San Francisco and the San Andreas Fault.
There is no need to develop beyond these three main types of rock groups except in relation to local rocks found in field work. Study of thin sections are desirable though not essential.

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1.3.1. The soil

Weathering and the formation of soil - physical and chemical processes of weathering, soil constituents, particles, sizes and structure, mechanical analysis and chemical reactions (pH), colloids and electrolysis.
Soil water - mineral salts and trace elements.
Soil atmosphere - presence of O_2, CO_2, N.
Living constituents of the soil (link with biosphere).
Soil profiles - horizons, leaching, flushing.
Soil management - fertility, conservation and erosion - salination, irrigation.

1.4. THE BIOSPHERE

The origin and nature of life - organization of organic matter by energy. The Biosphere - definition - area occupied by living things.
The physical and chemical factors that determine the forms of life in the sea, the land, the air.
Problems for life forms in these major realms.

1.4.1. Conception of the circulation of elements

Taking as examples:

Oxygen cycle; Carbon cycle;
Nitrogen cycle; Phosphorus cycle

(Link with Lithosphere, Atmosphere)

1.4.2. Methods of obtaining energy

The significance of autotrophic and heterotrophic nutrition.
The conversion and use of food energy by plants and animals.
Adaptations of heterotrophic organisms for

Attention should be drawn to coal and oil measures and the energy locked up in these resources. Mineral resources should be linked with rock types (e.g. Cu with igneous; Fe with sedimentary). Students should be able to interpret large-scale topographical, geological, land use and other maps and aerial photographs.

1.3.1. The soil

Soil study should be approached in a practical and experimental way, closely connected with work in section 2. From these studies principles should be drawn which relate to world conditions.

Pupils may work with soil in the school garden or see cultivations on a farm and relate them to these principles.

Soil managements should be stressed and reference made to the USA dust bowl crisis and other examples of mis-use.

1.4. THE BIOSPHERE (35 hours)

Sections 1.4. and Section 2 should be dealt with together and where possible the observations and demonstrations needed should be drawn from the field study.

1.4.1. Conception of the circulation of elements

This must be understood, taking as examples the routes of the four cycles listed. One of these should be studied in greater detail. In field work some quantitative estimate of these elements at some part of their routes should be observed. Practical work with plants, legumes in farming are important.

1.4.2. Methods of obtaining energy

The whole of this section should be approached in relation to the field work of section 2 and by carrying out experiments in the laboratory. A good understanding of photosynthesis is expected including a knowledge of the chemical pathway, cyclic and non-cyclic photophosphorylation, light and dark

obtaining food. Food as a source of energy, carbohydrates, fats, proteins, vitamins, and minerals.

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reactions, the structure of chloroplasts and their location, absorption spectra, radio-active tracer techniques and the compensation point which will link this topic with respiration.
The physiological and chemical processes involved in anabolism and katabolism should be covered with sufficient reference to anatomy to understand them. There should be a demonstration dissection of a mammal to show the main organ systems. Homeostasis should be understood. An outline of the range of adaptation suiting the organisms to their environments should be included rather than specific detail, e.g. behavioural, structural, geographical, environmental.
The candidate should have a basic understanding of food groups and their uses in living organisms. The interaction between autotropic and heterotrophic organisms, and the effects of imbalance between them should be clear.
Food should be seen as a measurable source of energy: the determination of calorific value of carbohydrates, fats and proteins using a calorimeter can be included - links with carbon, nitrogen, oxygen cycles should be clear.
It is very important that a complete understanding of the inter-dependence of photosynthesis and respiration is gained.
Clear illustration of the importance of conversion rate is shown in agriculture (pigs; beef cattle).

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Section Two: The Ecosystem

The student will carry out an ecological study in the field in connection with this section to illustrate the theme of energy flow, through the following topics:

2.1. CLIMATIC AND EDAPHIC FACTORS

Air and ground temperatures, rainfall, humidity, wind velocity and direction, aspect, situation, drainage, height above sea level. Rock type, soil type, minerals, humus, pH, water content, structure of soil.

2.2. PYRAMIDS OF NUMBERS

Populations.
Energy flow and nutritional relationships.

Section Two: The Ecosystem

Teaching time suggested: 80 hours.

There are two alternative possibilities to the field work in this section - one is to use 'natural' habitats such as woodland, ponds, coast line, the other is to use 'man-managed' habitats such as a school garden or farmland. The latter may prove useful, particularly in schools with rural studies facilities.

The study may be carried out on a single site either near enough to the school for frequent use or, ideally, within the school grounds so that equipment can be left out without too much interference. The school garden or estate may offer many opportunities.

On the other hand, studies to illustrate different parts of the section in different areas may be developed as required, and visits to managed environments such as forests or farms may be needed.

2.1. CLIMATIC AND EDAPHIC FACTORS

(Teaching time is not broken down in this section).

This should be closely related to the work on section 1.2.3. Pupils must be able to measure and record all of the factors listed and should know the effects of these on living organisms in detail. They should be able to carry out a detailed soil analysis. The effects on plant growth are more easily measured in a garden and greenhouse controlled environment than in natural conditions.

2.2. PYRAMIDS OF NUMBERS

Simple quantitative assessments of a given population should be included - where possible practical observations of food requirements both in the field and laboratory. Numbers relative to size, nutritional requirements and distribution within the area being studied should be measured or assessed. The relative importance of different species should be assessed in terms of their contribution to the energy

2.3. FOOD WEBS

Examples and principles.
Gross and net primary production - (plant respiration).
Primary consumption - herbivores.
Secondary consumption - carnivores.
Decomposers and parasites.
Energy flow through food webs.

2.4. ECOLOGY OF POPULATION

Factors affecting distribution and dispersal of plants and animals.

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flow - not in terms of biomass. Concentration on the few important species may be more valuable. The practical field work could not be taught before May in South East England.
(The comparison of the efficiencies of the herbivore and carnivore levels as energy converters in connection with man's exploitation of them as food sources can be considered in 1.4.2. above).
The metabolic costs of rearing animals to certain ages should be considered as the measure of the efficiency of exploitation. Link with Section 3. Population explosions can be observed in pest outbreaks arranged in a garden (aphis). Wireworm counts well documented.

2.3. FOOD WEBS

The student should observe and attempt to construct food webs from the evidence obtained in the field. The food webs should be seen as an essential preliminary to understanding community dynamics.
Students should know the range of primary production values and compare with a general scale.
Limiting factors should be considered.
Primary consumption - herbivores. This trophic level is the one most widely exploited by man. The possibility of developing this level should be considered in relation to human population growth.
The secondary level of carnivores can be compared in terms of energy conversion.
Decomposers and parasites. (Micro-organisms can account for 90% of the energy flow within the ecosystem). This level should be seen as processing a higher proportion of plant production than do the herbivore and carnivore levels. Similar attention can be given to insects and small animals. Energy flow through food webs should be demonstrated using diagram models for simplification.
The student should calculate food chain efficiency. (Assume a constant ecological efficiency of 10% which represents $\frac{\text{Calories gained by predator}}{\text{Calorific value of prey}}$)
Parasitic control of white fly in greenhouse. A school garden will provide illustrations, e.g. cabbage white butterfly parasites and hyperparasites.

2.4. ECOLOGY OF POPULATION

Examples of density-dependent and density-independent factors

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2.5. POPULATION, CONTROL MECHANISMS

Reproductive capacity.
Diversity of organisms.
Dispersals and migrations.
Population growth and its natural regulation.
Competition, food and predators.

2.6. ECOLOGY OF COMMUNITIES

Colonization by plants and animals.
Successional processes in ecosystems - seres, sub-seres and biotic or climatic climax communities.

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should be considered.
The competitive relationship between populations in the same trophic level - a horizontal relationship, should be noted.
Some estimation of population size using the Lincoln Index method should be carried out. The ecological niches may be observed in the field.

2.5. POPULATION, CONTROL MECHANISMS

Examples can be shown of the potential numbers and population build-up in one species of animal and plant (field work for late summer and autumn terms), starting from a field situation, but reinforced by laboratory experiments, e.g., locusts, stick insects, aphids.
Reproductive capacity - consideration of optimum density for a species can be made. Observations could be made of infant and egg mortality. Cycles of abundance - seasonal and periodic should be demonstrated if possible.
Diversity of organisms should be considered and a diversity index calculated.
Dispersals and migrations - migrations in the field study should be related to vertical, horizontal or combination migrations. Diurnal and seasonal migrations and their causes can be observed.
Hormones and the migratory urge should be considered.
Active and passive dispersal can be observed. The principles of population growth and its natural regulation should be understood, examples of predation, inter and intra specific competition can be shown in the field or laboratory experiments (blow-fly larvae).
Application of the principles to the human population explosion should be made. Relate to section 3.
Dispersal and migration - cabbage white butterflies from continent; aphis from alternative hosts.
Discuss side effects of control attempts - red spider increase in orchards.
Plant competition can be illustrated in a school garden by seed sown thickly, by weeds remaining.

2.6. ECOLOGY OF COMMUNITIES

It is necessary to study an area which is developing and not static or climax.
Effects of changes in grazing pattern of permanent pastures (sheep on chalk land) can be seen.

Section Three: The Interaction of Man and the Environment

3.1. MAN AS A HETEROTROPHIC ORGANISM

3.1.1. The satisfaction of his fundamental requirements (food, oxygen, warmth, shelter)

3.2. THE EVOLUTION OF MODERN MAN AS A TOOL-USING, RATIONAL CREATURE

Section Three: The Interaction of Man and the Environment

Teaching time suggested: 80 hours.

The theme developed in this section is that man is one species that has, by virtue of his particular evolution (biological and socio-cultural), reached a stage where his impact on the environment is so great that he must control it or destroy it.

Through the domestication of plants and animals man has been able to replace natural biotic communities with those serving his immediate ends. The harnessing of new energy sources and the transmutation of materials into other forms have vastly increased his capacity to alter his environment.

3.1. MAN AS A HETEROTROPHIC ORGANISM (30 hours)

The generalized anatomical structure of man, his specialized hands, upright posture and large highly differentiated brain, his neontogenetic characteristics and the long dependency period of human infants should be appreciated by comparison with other primates. These biological characteristics should be considered as the biological basis for man's behavioural adaptations.

3.1.1. The satisfaction of his fundamental requirements (food, oxygen, warmth, shelter)

This could be done by comparing how these requirements are satisfied in different societies today or at different economic levels of our own society to get across the point that even in our sophisticated urban conditions these needs still require to be met. Alternatively various needs could be studied in terms of their non-satisfaction (malnutrition, anoxia, hypothermia, heat-exhaustion, etc.) - the effects of these conditions on the human organisms. Food requirements to be linked to section 2 detail.

3.2. THE EVOLUTION OF MODERN MAN AS A TOOL-USING, RATIONAL CREATURE (30 hours)

Man's social organization and cultural adaptations should be considered in relation to his control of his environment.

3.2.1. A consideration of hunter, pastoral and agricultural societies

3.2.2. Man's domestication of plants and animals

3.2.1. A consideration of hunter, pastoral and agricultural societies

Each of these types of technology should be considered with regard to their relationship with their environment and their impact on it. Two broad strategies are possible in choosing examples. Examples could be chosen to show the development of technologies and societies and consequent environmental change in a single area through time, e.g. Britain, USA, Australia. Or examples could be chosen from a wider geographical historical range to give detailed 'snap-shot' studies of man-environment relations, e.g. Pygmy hunters and gatherers, Masai pastoralists, tropical forest cultivators. There is no reason why a time sequence should not be introduced within each of these examples - for instance a study of the impact of the horse on Plains Indian society would be in order.

In some respects the educational value of a series of unrelated cultures may be less than a study following a time sequence in one area, on the other hand, the former might allow a more detailed study of the relationship between subsistence technologies and the environment within each example in so far as it allows the teacher to choose the best documented examples.

What should be stressed in this section is human society as an ecological factor. Where possible the pressures on the environment imposed by the technologies exemplified, should be specified.

The dangers of 'environmental determinism' should be avoided in this section. The best corrective is wide reading by the student.

3.2.2. Man's domestication of plants and animals

From the previous section will arise a study of man's domestication of plants and animals as evolutionary factors. Indeed there is no reason why, in teaching, parts of section 3.2.1. and 3.2.2. should not be taught together.

In this section, however, a more global perspective is required. The diffusion of domestication from society to society and by the migration of peoples should be con-

3.2.3. Man's use of mineral resources/
3.2.4. Man's acquisition of energy exploiting techniques and their application to his evolutionary success

Tools, the development of power sources (animal, wind, water, fire, steam, internal combustion engine, electricity, atomic fuels).

3.3. PRESSURES ON THE ENVIRONMENT

Introduction to the main pressures - population increase, industrial growth.

sidered, and the effects of agriculture and pastoralism on the environment should be dealt with, i.e. the disappearance of forests, the settlement of mountains, the drainage of marshes, the irrigation of arid lands, the creation of deserts, should be considered on a global scale. The present day tremendous advances in intensive agriculture must be considered fully.

No detailed knowledge of genetic mechanism is required but the student should have an understanding of the principles of natural selection and their application to artificial selection. The theme stressed in this section is the replacement of biotic communities with those serving man's immediate goals, and the consequence of this.

3.2.3. Man's use of mineral resources/
3.2.4. Man's acquisition of energy exploiting techniques and their application to his evolutionary success

The growth of man's control of power should be considered historically, stressing the increasing demands made on the non-renewable resources of the earth as technology advances. The changing relationship of industry to its resource base (e.g. the way electricity, gas and oil have allowed industry to move away from the coal fields) and the present social need for computerized large scale industry should be stressed.

Both these sections could be approached either against a British or a world background.

This section should establish the increasing control/impact on environment made possible by the massive exploitation of energy sources and the transmutation of materials on a large scale.

3.3. PRESSURES ON THE ENVIRONMENT (20 hours)

The evolutionary theme that has been followed along physical, then biological and historical pathways is continued by studying environmental problems in the underdeveloped areas separately from those of the developed areas of Europe and North America. It might be considered that pressures on the environment in an underdeveloped

3.3.1. Reproductive capacity and population explosion in underdeveloped countries, social checks on population, rising expectations, results of modern medicine on decline of death rates.

3.3.2. The industrial revolution

The ways in which the problems now confronting underdeveloped societies have been tackled in advanced areas through legislation.

3.3.3. Effects on the environment of urbanization

A concise history of urbanization in Britain (post 1700). Effect of transport developments on patterns of urban growth. The development of government controls and planning legislation. The practical effects of these.

3.3.4. Mechanization and intensification of agriculture

Special problems resulting from the application of industrial methods to farming. Problems of depopulation.

3.3.5. Further illustrations of pressures on the environment resulting in degredation - deforestation, effects of monoculture, erosion and salination, chemical and radioactive pollution, sewage disposal, garbage, traffic congestion.

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society may be different in kind from those in a developed, industrialized and urban society.

3.3.1. Reproductive capacity and population explosion in underdeveloped countries

Pressure of peasant agriculture on limited land, overcropping. Migration to 'shanty towns' or cities. Population pressures on land. Studies of particular examples such as Mauritius, Calcutta, or Hong Kong are available.

3.3.2. The industrial revolution

Studies of the social history of Britain in the 19th century are available in many books. The student here is concerned only with the environmental aspects. Outline of public health and housing legislation, government controls on industrial siting.

3.3.3. Effects on the environment of urbanization

This should be studied with reference to an area known to the student, if possible. The use of superimposed maps of urban growth is suggested. Particular reference should be made to current developments, concepts of resource destruction, and planning blight. Local case histories should be discussed.

3.3.4. Mechanization and intensification of agriculture

Special problems arising from mechanized farming, combined with maximized returns on investment, monoculture, destruction of hedges, effect on wild life and soil. Social effects of depopulation, rural planning, access to countryside.

3.3.5. Further illustrations of pressures on the environment resulting in degredation

Research into current information in recent publications and journals should be encouraged. Confirmed case histories should be studied.

Section Four: Environmental Conflicts and Planning: a Field Study

The student will be expected to select one topic from the list shown at the end of this section and submit it to the Board for agreement at an early stage of the course.

The study will be concerned with the interaction of man and the natural or built environment, i.e.

a) the influence of man's social and economic activities on land use, natural resources, townscape and buildings, and on the balance of living things in the ecosystem;

b) the effect of change in the natural environment and the ecosystem on man's activities.

In this section the student will be expected to draw on material from all previous sections. The headings listed below are to be regarded as a check list and should be brought into the study only where relevant to its objectives.

The emphasis should be on the inter-relationship of processes and activities outlined in the syllabus and the internal details only in so far as they affect these interrelationships.

The student will be expected to find evidence for himself and to come to a judgement on the environmental pressures involved in the situation being studied.

The study will also be a test of the student's familiarity with the techniques of analysis and evaluation, his grasp of content, handling of sources, ability in communication and presentation.

Section Four: Environmental Conflicts and Planning: a Field Study

This section must involve the pupil in making his own observations in the field. Primary information sources such as census returns and other official data, interviews, etc., are to be preferred to secondary sources such as books and articles, although the latter may be used for supplementary information and general background.

Guidance by the teacher should include preliminary advice on methods of work and sources, the organization of contacts with outside bodies, tutorial oversight, and some teaching of the required techniques of field work.

The provision of experience in the use and analysis of statistical material is important. The student must be responsible for the overall planning and for the accuracy of his own observations, his deductions and the calculations or descriptions included in this field work.

The teacher should guide the student to select an enterprise where there are obvious environmental impacts.

There is no objection to a number of students following the same subject, provided that this is borne in mind and that each makes his own value judgements and assembles his own evidence; there would be no objection to using figures obtained by another student, provided that the source is acknowledged.

The fieldwork should show original first-hand investigation; an understanding of the implications of the problems investigated for the total environment; appreciation of the limitations of the methods and results; experience of scientific method in the collection, assembly and evaluation of evidence; clarity of presentation of arguments using diagrammatic as well as written expositions; reasonable judgements that are based on evidence and not prejudice. The standard of presentation should be considered but is obviously not so important as the other factors.

4.1. THE ENTERPRISE

4.1.1. Identification

Define the enterprise and area - its type name, size and location.

4.1.2. Historical development

Where this has had an effect on the present situation; to include factors affecting the siting of the enterprise.

4.1.3. Management and its aims

Aims and methods of management of the enterprise and relation to general practices in the industry - ownership, capital sources, labour and organization, degree and effect of technological change, where they have an effect on the environment.

4.1.4. External influences

Communications and markets, technological change, legislation affecting the enterprise; social attitudes towards change; influences exerted by advisory services and pressure groups.

4.1.5. Resources base

Space
Raw materials
Water
Fuel and power

The teacher should study very carefully the criteria of assessment for fieldwork given later and take care that the report does not become largely descriptive in terms of biological, geographical or historical information.

4.1. THE ENTERPRISE

4.1.1. Identification

The student should not write geographical description, per se but should write a brief identification in the terms of the headings suggested.

4.1.2. Historical development

The student should not write a historical description of the development of the industry as such, but should concern himself with those historical factors which have influenced the present form of the enterprise.

4.1.3. Management and its aims

In this section the student should consider those aspects which have had an effect on the environmental situation. He should consider whether the aims of management are entirely commercial.

4.1.4. External influences

It is not necessary for the student to know Countryside Planning Acts in detail, but he should be aware of the major acts and the duties these have imposed on public authorities and private individuals.

4.1.5. Resources base

An important consideration is the limitation of the resources base - rate of exploitation and life expectation. In the case of extractive industry the relationship is clear. In agriculture or forestry the most important resources are renewable (soil - trees - water) and the important consideration is whether this has been allowed for and whether the balance is being maintained.

4.2. ASSOCIATED NEEDS

4.2.1. Housing and special facilities

Description of the housing - quality, density, layout, accommodation capacity for the population. Provision for health, shopping, education and leisure.

4.2.2. Infrastructure

Transport, communications, including pipe-lines, transmission of energy and waste-disposal systems.

4.3. IDENTIFICATION OF ENVIRONMENTAL EFFECTS

The student should identify any environmental implications connected with his enterprise for: space; minerals; soils; wild-life; micro-climate; water; and scenery.

4.2. ASSOCIATED NEEDS

4.2.1. Housing and special facilities

The student should be allowed to consider the relationship between housing provision, social facilities and the employment provided by the enterprise, both in terms of quality and its impact - visually and on the natural environment.

4.2.2. Infrastructure

The student should not simply record the presence of these factors; he should consider their effect on the environment.

4.3. IDENTIFICATION OF ENVIRONMENTAL EFFECTS

Space: The effect of the enterprise on space in the sense of area and relief - hills and valleys. Slopes and holes are resources, e.g. space is needed for building. The importance of slopes for drainage or for recreation.

Minerals: These may be sterilized by building over them; acquifers may be harmed by industrial effluent or archaeological sites may be destroyed.

Soil: Soil quality may be improved or harmed; erosion or compaction may result from heavy use.

Wild Life: Wilf life may be destroyed or reduced; its direct economic, educational, recreational or research value may be affected; it may be provided with new habitats e.g. on motorway verges.

Micro-climate: (Micro-climate in the geographical sense). Winds may be influenced by tall buildings or shelter belts, area pollution may occur.

Water: Run-off may be increased. Water may be heated, polluted or re-directed.

Scenery: The teacher should realize that it is very difficult to deal with this section without making subjective judgements as to whether the activities of the enterprise improve or spoil the scenery. Many new developments may be thought of as improving scenery.

4.4. EVALUATION AND PLANNING

4.4.1. Evaluation of impacts

Assess the importance of the impacts on environment. Identify in your study, in terms of the value of the items listed in 4.3 the degree to which they are affected, and the range of people involved.

4.4.2. Planning

Knowledge of planning legislation and the policies adopted by the community or by the individual enterprise.

4.4.3. Judgements

Effects of these planning policies on the environment, consideration of any further problems which might arise and suggestions for conservation in the future.

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4.4. EVALUATION AND PLANNING

4.4.1. Evaluation of impacts

The value of the items may be assessed in terms of their present and potential suitability for various purposes, their rarity and how easily they can be replaced.

The student should assess the degree to which these items have been affected in terms of both quantity and intensity of the impact. The assessment should include a variety of points of view, e.g. local residents, tourists, landowners, ratepayers, shop-keepers, workers etc., where necessary.

4.4.2. Planning

The student should find out what planning and management policies have been applied in this case. Applicable legislation should be known.

Planning policies should include decision-making, predicting and management by agencies other than the local planning authority, e.g. Ministry of Agriculture, a landowner, urban property company, and amenity pressure groups; the resolution of conflicts.

Different types of planning policies may be distinguished, ranging from land purchase and development through various positive policies of improvement or negative policies of control to persuasive and advisory policies.

4.4.3. Judgements

The teacher should be aware that there are no absolute criteria and that not all conflicts are bad. The student should know that, in the last analysis, his argued judgements can only represent his personal point of view.

Appendix: List of Subjects for Submission as Field Study

INDUSTRY	AREA	Village or Town or neighbourhood	Rural area	Redevelopment area	Town Central area	National Park
A Agriculture Horticulture Forestry Fishing						
B Coal Mining Iron ore mining and steel production Stone or slate quarrying and mining Chalk, limestone and cement manufacturing Clay extraction and pottery or brick manufacturing Sand and gravel extraction and distribution Petroleum or quarrying operations Gas/Electricity/Water production and distribution Other mining and quarrying operations						
C Construction of major motorways, etc. Airport, or port activities Recreation or tourism enterprises						

D Other enterprises where environmental conflicts may exist that the school may submit to the Board for consideration.

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Appendix: List of Subjects for Submission as Field Study

The student will select an example of one industrial enterprise from the vertical list related to one community of the horizontal list (e.g. a steel works in a redevelopment area, a stone quarry in a national park, or a farm in a rural area). The enterprise and community selected should be within convenient distance of the student's school for frequent visiting and field work.

Appendix: Teaching Notes

The industrial groups suggested are those directly related to the biosphere or extractive industries related to the lithosphere or industries having an obvious effect on the natural environment and landscape.

The settlement areas are designed to limit the study - for example, a steel works in Britain might draw its raw material from Sweden, but the student should see the whole process in one area if possible. At any rate, the student should not be expected to give detailed consideration to the effects outside the limits of his area, although obviously he should be aware of them.

A Redevelopment area may be designated by the local planning authority as a 'Comprehensive Development Area' (CDA) or as an 'Action Area'. The general intention to replan the area comprehensively is the same in each case although the legislative controls and procedures are rather different. (This aspect should not concern the student). The area might be residential, commercial, industrial or one of mixed use.

'Central Areas' are normally defined for most towns on the planning authority's development plans, and this can be taken as the area of study.

The size of the area will need to vary according to the type of industry being studied. For an airport one might be studying a very large rural area, e.g. North East Hertfordshire, parts of Essex and Cambridgeshire for Nuthampstead; the Lea Valley between Hoddesdon and Cheshunt for the glasshouse industry; or the Vale of St. Albans for gravel working. In this context, the town, village and rural areas cannot really be divorced from each other.

Criteria for the Examination of Field Work Submission from Section 4

The examiner should first read the submitted report before attempting any mark analysis and then award marks on the following pattern out of 100.

1. Content	Max. Marks
1.1. To what degree does the report show the correct use and interpretation of information gained in sections 1 - 2 - 3 of the syllabus?	10
1.2. Does the student relate the particular enterprise studied to general conditions in the industry (i.e. is it typical etc.) in detail?	5
1.3. Does the student appreciate the potential of the enterprise for dangers to, or improvement of the environment?	5
1.4. Is there a clear knowledge of planning and environmental legislation and management policies and their effects in detail?	5
2. Evidence of original first-hand investigation	
2.1. Was the data used directly obtained by the student in the field?	10
3. Scientific method in the collection and evaluation of evidence	
3.1. Was the data collected on a methodical plan i.e. was sampling properly considered?	5
3.2. Was the data appropriate and sufficient for solving the problem?	5
3.3. Has the student used the best techniques?	5
3.4. Has the student interpreted the results logically?	5

3.5. In his handling of sources are the acknowledgements precise? 5

3.6. Are the limitations of applied figures from other sources recognized? 5

3.7. Were there any omissions, i.e. was any important factor overlooked? -10/0

(It must be clear in every case how evidence or data was obtained)

4. Appreciation of the limitations of the methods used

4.1. Does the student show specific awareness of this factor in his assessment of his evidence? or does he make claims that are in excess of what the evidence really supports? -5/5

5. Evidence of deductive reasoning shown in drawing conclusions

5.1. Are conclusions throughout the report logically deduced from evidence? or does prejudice or poor reasoning show? -5/5

5.2. Are the judgements made by the student in consideration of the environment conflict valid? (They may be subjective to some degree so long as the student is aware of this and points it out). 10

6. Presentation

6.1. Is the environmental conflict set out clearly? 5

6.2. Are arguments presented as clearly and concisely as possible? (The use of graphs, ideographs, maps and charts should be included as well as written argument). 5

6.3. Is the quantitative information and argument accurate and of a sufficient precision? 5

Methods of Examining

It is important that the teacher should be involved in the assessment of the course and provision is made for this in D below.

At the end of the course the pupil should be able to answer in a critical and analytical way and come to some judgements.

Questions in paper C should cover the detail of sections 1, 2, 3, while integrated questions across the whole syllabus should be offered in paper E.

To answer paper E the pupil should have available his field work submission so that he may be able to illustrate his answers from his own research material. There appears, to the working party, to be no value in his having to recall data without such help and indeed this would limit the value of his own investigations.

		%
A	Submission of the field work on section 4 - externally examined	20
B	Examination of section 4 field work - external oral	10
C	Written examination of 3 hours on sections 1, 2, 3, externally examined	30
D	Teacher's assessment of the fieldwork of section 2	10
E	Written examination of 3 hours on principles integrating the whole syllabus including section 4	30
		100

Specimen Question Papers

The papers have been designed to cover the syllabus. To ensure that the questions are at an even level they have been analysed with the help of Bloom's Taxonomy of Educational Objectives.

In producing these sample questions the Working Party have been concerned primarily to show that the syllabus can be examined at the appropriate level and although the questions offered are of a traditional type, had more time been available they would have preferred to have presented more questions on patterns such as that illustrated by question one of paper E.

Each question in Paper C ranges from knowledge of specifics, trends, methods and principles to extrapolation and application.

Questions in Paper E range from application to analysis and occasionally to synthesis. Question 1, a compulsory question, in this paper offers opportunities to the more able student to evaluate.

'A' level specimen paper 'C'

Candidates should answer 5 questions: not more than 2 from any one section. All questions carry equal marks. Three hours for the whole paper.

Section 1

1. Describe the wave nature of radiation and the spectrum of solar radiation. What factors exist preventing parts of the spectrum hostile to life from reaching the surface of the Earth? Explain the 'greenhouse effect' of the atmosphere and its effects on climate.

In what ways might the pattern be altered by the pollution from modern technology? Give evidence or authorities to support the various points of view.

2. Explain how you would determine the physical and chemical properties of a soil sample.

Detail the soil conditions of an area you have studied and relate these to EITHER cultural requirements OR vegetation types.

How might modern agricultural practices endanger soil structure? Is there any evidence of this in Britain?

3. The overall photosynthesis is often represented as

$$6CO_2 + 6H_2O \text{ energy } C_6H_{12}O6 + 6O_2$$

Describe in detail the process of photosynthesis and discuss how a full understanding of this process might be applied to commercial horticultural practice.

4. Explain diagrammatically the cycle of the circulation of one of the elements - oxygen, carbon, nitrogen or phosphorus. Detail and relate to the cycle any observations you have carried out in the field.

5. 'The reliability and the effectiveness of the rainfall are more meaningful than the average annual rainfall.' Explain with examples the environmental and economic implications of this statement.

Section 2

6. Describe, with quantitative information, a food web you have traced in your field work. Indicate the energy losses in the conversion processes at various stages. What bearing does this have on the problem of the use of animal protein as human food?

7. Describe the distribution of any one species in a habitat you have studied. Suggest the factors that have influenced distribution and give quantitative evidence.

8. How would you carry out an investigation in a controlled environment to determine the factors influencing ONE of the following:

(a) the growth of pea plants;
OR (b) the fruiting of tomato plants;
OR (c) the flowering of chrysanthemums.

Discuss the relevance of one of the factors you have investigated to the ecology of a habitat you have studied.

9. Many plants and animals produce a great number of seeds or eggs. Explain why the populations in a habitat may generally remain stable and support your answer by suggesting experiments and giving evidence from your own field work.

10. Describe with examples what is meant by biological methods of pest control. Give your views on the possibility that biological methods may eventually replace chemical methods of pest control.

Section 3

11. 'An increase in population of 100 people in Western Europe will have a greater impact on the environment and on natural resources than an increase of 2,000 people in South-East Asia.' Discuss this statement.

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12. How have transport developments in twentieth-century Britain changed the nature and size of urban areas? What has been done to stem the spread of such areas? Illustrate your answer by reference to a locality you have studied.

13. How does your local area dispose of its domestic waste (sewage and garbage)? Is this method satisfactory on health and environmental grounds? What problems would arise if there were to be a large influx of population over the next ten years?

14. Suggest some of the economic and social reasons for the original planting and present-day removal of hedgerows in the development of the countryside. Discuss the possible ecological consequences of the present removal of hedges.

15. Man requires food, warmth and shelter to survive. Compare the means by which these needs are satisfied in a particular subsistence society with ways in which they are satisfied in industrialized societies, relating each activity to its environmental consequences.

'A' level specimen paper 'E'

Answer Question 1 and any 2 other questions. Three hours
Candidates should have their Field Notes available

You should illustrate your answers from your own field work where appropriate and marks will be given for this, as well as for knowledge of the relevant information and authorities, for clearly expressed argument, careful analysis of evidence and logical conclusions. Where appropriate, you will be expected to draw from the whole range of the syllabus.

All questions carry equal marks.

1. Study the material provided.
   a) O.S. 1"/Km. map of an area of Britain showing land use,

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available water, sewage disposal possibilities, mineral resources, electricity grid, derelict land, sites of special scientific interest, land of outstanding natural beauty, conservation areas.

b) Population statistics for the region.

c) An outline of the industrial enterprises that require to be settled.

d) A small scale map showing adjacent major centres of population, trunk routes, airfields, ports.

e) A nature conservancy assessment of the area.

f) A list of recreational areas (country parks, lakes, coastline, regional parks).

g) Table of costs and other necessary data.

h) Tracing paper for rough working.

i) Transparent overlay for the final siting.

Using the transparent overlay, site a town of 100,000 people. The residential area will occupy 20 sq. km., the industrial area 3 sq. km. and the central business district 2 sq. km. Using the national grid squares, make a decision upon the siting of each part of the town, its essential services, communications, and power links, causing the minimum conservation disturbance. Justify your decisions from cost, aesthetic and conservation aspects.

2. 'The distribution of new towns in Britain should be closely related to the availability of water for industrial and human consumption.' Explain the water cycle, its geographical and biological significance and relate it in detail to the problem of siting a new town.

3. Compare the fluctuations in population of any species of animal under natural controls with the human situation today. Discuss the causes of and effects of the rapid human population rise in tropical regions since DDT has become available.

4. Discuss the importance of the industry of which you have made a special study, to the industrial development of Britain; the problems caused by its expansion and the solutions envisaged.

5. Describe the nature of atmospheric pollution caused by large cities and industrial areas. What are the effects of such pollution on wild life? Discuss and assess the possible long-term hazards to human welfare. What controls are exercised in Britain? How

effective are they and what further controls, if any, do you think are needed?

6. What factors are responsible for determining the type of farming in any particular area? Discuss the relative effectiveness of these and illustrate your answer by reference to a specific farm.

7. One of the arguments for the conservation of a species is that it acts as a 'gene bank'. Explain this and outline the biological, social and economic arguments used for and against conservation, where development has led to the danger of a particular species of plant or animal becoming extinct.

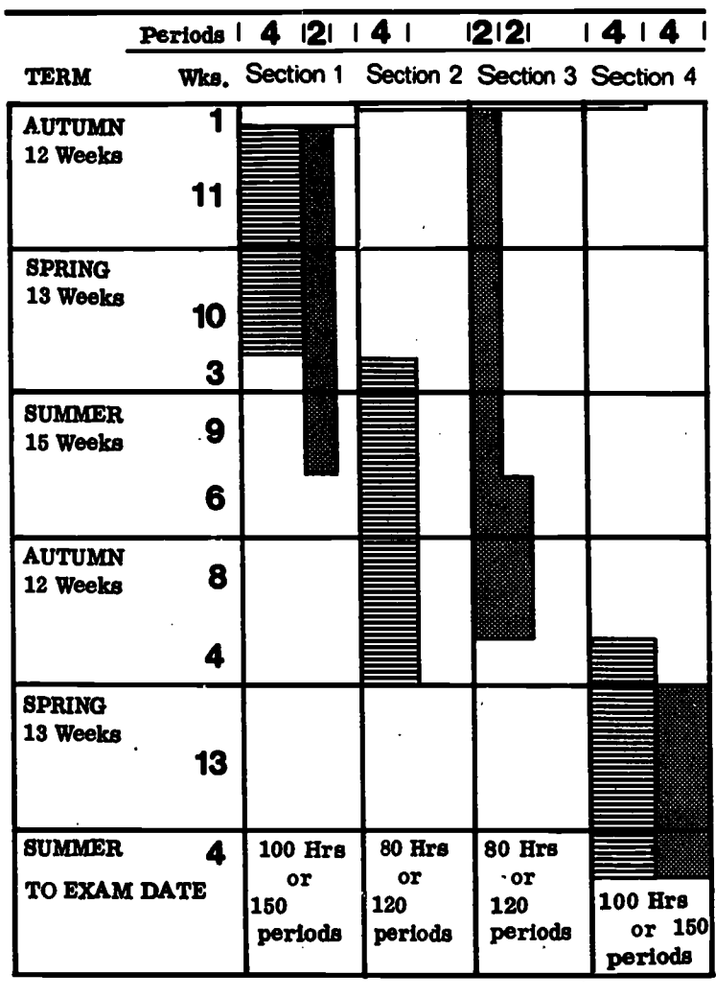
8. Describe how the increased energy available to Western man has increased his potential environmental impact and discuss the effectiveness of the controls that have been introduced in Britain since this situation was realised.

9. Explain the energy cycle of a forest. Justify the statement that forestry needs long-term planning, and discuss the relationship between the objectives of forestry as an economic activity and the objectives of water catchment, amenity and wild life conservation.

Note: It is the aim of the Working Party that candidates answer the questions very fully and do not feel rushed.

Timetabling

Suggested timetable allocation at 8 periods of 40 minutes per week for 64 weeks. The working party suggest that Section 1 and Section 3 are started at the same time; Section 2 which is mainly field work is carried out in summer and autumn and Section 4 is taken at the end of the course. The hatching illustrates how the time might be divided equally between two teachers.



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Membership of the Working Party

The Working Party for 'A' level Environmental Studies was made up of teachers in Hertfordshire schools; the membership varied at different stages; a number of Head teachers attended some sessions. The Working Party are particularly grateful to Dr. J. Kitching of Durham University, Institute of Education and to Miss B. Hopkins of University of London - Schools Examinations Department, for their attendance and continual guidance.

In addition the Working Party wish to thank those who contributed detailed constructive criticisms of the content and help in drawing up teaching notes, including the members of the October 1970 Conference held at Offley Place.

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Resources List

PREPARED text books for an A-level course in a new area of study such as this do not exist, so it will be necessary for the teacher to guide the student's selection from a wide range of material. The following list deals primarily with books, filmstrips and so forth and then, in separate sections at the end, with extra films, periodicals and equipment. The list follows the same order as the foregoing syllabus, being divided into corresponding sections for easy reference back and forth. Some items occur under several sections, and in this case the full details of the item will usually be found where it occurs first. Gaps in the numbering are due to the method of compilation and have no other significance. Every item in the list has been inspected and approved by the appropriate section of the resources group of the working party. The short list which now precedes the Resources List proper refers to those items containing basic subject matter of the course.

Short list:

RL 2	RL 74	RL 565
RL 6	RL 96	RL 586
RL 12	RL 106	RL 607
RL 22	RL 114	RL 609
RL 25	RL 122	RL 616
RL 35	RL 123	RL 628
RL 41	RL 189	RL 630
RL 48	RL 500	RL 639
RL 49	RL 501	RL 781
RL 65	RL 505	

Section 1,1 THE SOLAR SYSTEM

RL 1 Scale; NUFFIELD: Physics Teachers' Guide V; p. 99; LONGMANS, 1970; £1.25; 360 pp.

RL 2 Tides, gravity, geometry, elliptical orbit, inclinations to ecliptic, eclipses, pressure in sun, gravitation force; RUGGIERI, G: Secrets of the Sky; 1st two parts; HAMLYN, 1969; £1.25; 174 pp.

RL 3 Solar system, etc. The Changing Heavens Series; 89-4202/1; EALING SCIENTIFIC; US $24.95; 3-4 mins. each; film loops; colour; Super 8 (6 in series)

RL 4 Outline of galaxy; importance of sun as energy source; expl. of climatic regions, seasons, day and night, relevance to photosynthesis; Under the Sun; GAS COUNCIL; free hire; 9 mins; 16 mm. film; colour.

RL 5 Earth-sun relationships; Day & Night & the Seasons Series; 5960; ENCYCLOPAEDIA BRIT; £5.50; study prints; colour; (8 in series).

Section 1,1,1.

RL 6 Forms of energy; HARRISON, G.R: The First Book of Energy; GROLIER SOCIETY; 1967; £0.75; 81 pp.

RL 7 Energy; NUFFIELD; Physics - Guide to Experiments II; pp. 54-64; LONGMANS, 1967; £0.75; 205 pp.

RL 8 Energy; NUFFIELD; Physics Teachers' Guide II; pp. 54-64; LONGMANS, 1967; £0.75; 200 pp.

RL 9 Energy, Entropy, $E = mc^2$, Fission/fusion, Conservation of energy; ROGERS, E: Physics for the Inquiring Mind; pp. 390, 394-6, 403, 630, 400 ff; OUP: 1960?; £4.20; 778 pp.

RL 10 Rotation explained; Night and Day; G/P 214; SOUND SERVICES; £3.30; film loop; Super 8; colour; 3-4 mins.

RL 11 Earth's relationship to sun; Time; GP/218; SOUND SERVICES; £3.30; film loop; Super 8; colour?; 3-4 mins.

RL 12 Fraunhoffer Lines, Energy distribution, Factual Information about sun; ELLISON, M.A: The Sun and its Influence; 3rd ed.; Ch. 1, p. 31, ch. 2; ROUTLEDGE & KEGAN PAUL; 1968; £2.00; 235 pp.

RL 14 Good introduction to three types of radioactivity; Radioactivity; 80-3346/1; EALING SCIENTIFIC; £5.00; 3-4 mins; film loop; Super 8, colour.

RL 15 Nuclear, energy, fusion; The Nuclear Force; 3177203 PHILLIPS; £4.00; 3¾ mins; loop; Standard 8 colour.

RL 16 Introduction to subject for 'lay' students; Radioactivity; Cat. No. ?; ICI; Price ?; 21 mins; 16 mm. film; colour.

RL 17 Physical and chemical changes, laws of probability, heat as disordered molecular motion; The Laws of Disorder - I, Entropy; Cat. No?; ICI; Price ?; 22 mins; 16 mm. film; colour.

RL 18 Uranium Fission; 08.30; J. KING (Films) Ltd; 90p; film strip; B&W.

RL 19 The Atom - Man's Servant (Series of 6); 10690; ENC. BRIT.; £9 for set; (1.75 each); film strips.

RL 33 VAN ALLEN (see RL 33 below).

RL 20 Short wave conditions; Wireless World; monthly periodical; £0.20.

Section 1,1,2 The Transport of Energy

RL 21 Electro-magnetic radiation, reflection, refraction; JARDINE, J: Physics is Fun II, Ch. 6, 7; HEINEMANN, 1967; £0.75; 166 pp.

RL 22 Electro-magnetic spectrum; BAILEY, C.H: The Electromagnetic Spectrum and Sound; pp. 35-120; PERGAMON, 1967; £0.75; 130 pp.

RL 23 Infra-red, ultra-violet; NUFFIELD Adv. Level Physics UNIT 4; pp. 40-44

RL 24 Reflection, Albedo, Absorption; A. AUSTIN MILLER & M. PARRY; Everyday Meteorology; pp. 41-8; HUTCHINSON, 1965; £1.75; pp. 270.

RL 25 As RL 24 with (further data on Albedo); R.G. BARRY & R.J. CHORLEY; Atmosphere, Weather & Climate (2nd ed.); Ch. 1; METHUEN; 1971; £1.50; 380 pp.

RL 26 As RL 24 (more advanced); W.J. HUMPHREYS; Physics of the Air; Ch. 6; NEW YORK; DOVER, 1964; £2.00, 676 pp.

RL 12 ELLISON, M.A: (see RL 12 above).

RL 27 Energy conversion - chemical; thermal; mechanical; electrical; electro-magnetic, etc; Energy Conversion; 80-3437/1; EALING SCIENTIFIC; £5.00-£6.00; 4 mins; loop; Super 8; colour.

RL 28 Entropy; HC 1 HEINEMANN; £4.00; 3-4 mins; loop; Stand. 8; colour.

RL 29 Emission & Absorption of Radiation; SP/H/3; SOUND SERVICES: £4.50; 3-4 mins; loop; Super 8; colour.

RL 30 Absorption Spectra; 80.2025; EALING SCIENTIFIC; Price ?; 3½ mins; loop; Super 8; colour.

RL 31 Under the Sun; Cat. No. ?; GAS COUNCIL; Price ?; 9 mins; 16 mm. film; colour.

RL 32 Waves; 11230; ENC. BRIT.; Price ?; series of 4 strips; colour.

RL 33 Radiation belts; VAN ALLEN; Radiation Belts around the Earth; Sc. Amer. Offprint No. 248; Warner House, Folkestone, Kent; FREEMAN; £0.20; 10 pp.

RL 34 Behaviour of waves; Refraction of Waves; 80-234; EALING SCIENTIFIC; £3.62; 2¾ mins; loop; Super 8; colour.

Section 1.2 THE ATMOSPHERE AND HYDROSPHERE

Section 1.2.1 Atmospheric Layers and Filtsring Effects

RL 35 Simple intro. to atmosphere; D.C. KNIGHT; The First Book of Air; pp. 9-18; F. WATTS: 1971; £0.80; 380 pp.

RL 36 Atmospheric pollution; A.R. MEETHAM: Atmospheric Pollution; PERGAMON; 1964; £2.25; 300 pp.

RL 37 Basic coverage; N. HORROCKS: Physical Geography and Climatology; Ch. 10-14; LONGMANS; 400 pp.

RL 38 Basic coverage; F.J. MONKHOUSE; Principles of Physical Geography; Ch. 14-18; ULP; 1970; £2.10; 550 pp.

RL 39 Structure of earth's atmosphere - winds, depressions; air stability; and instability; O.G. SUTTON: Understanding weather; ch. 1-4, 8; PENGUIN; 1960; 215 pp.

RL 40 Thorough coverage; F.K. HARE: The Restless Atmosphere; HUL; 1966; 190 pp.

RL 41 SELBY; The Surface of the Earth, Vol. 2; Ch. 2.10; CASSELL; 1971; 438 pp.

RL 42 Gravitational Distribution; 80.2942; EALING SCIENTIFIC; £5.00; loop; Super 8; colour; atmospheric layers.

RL 43 Pollution; 89-4154/6; part. 87-1970/6 and 87-4156/6; EALING SC.; each £5.00; set of 6 film strips with records.

RL 44 Local, continental and natural pollution; Air Pollution Pt. 1; DIANA WYLLIE Ltd; £1.10; strip; colour.

RL 45 Industrial pollution; Air Pollution Pt. 2; DIANA WYLLIE Ltd; £1.10; strip; colour.

Section 1.2.2	Insolation
RL 37	N. HORROCKS. (see RL 37 above).
RL 38	F. J. MONKHOUSE. (see RL 38 above).
RL 39	O. G. SUTTON. (see RL 39 above).
RL 40	F. K. HARE. (see RL 40 above).
RL 41	SELBY. (see RL 41 above).
RL 46	The heat balance and exchange of energy; seasonal and diurnal variations over the world; GENTILLI, J: Sun, Climate and Life; Ch. 2, p. 12; BLOND: 1971; 200 pp.
RL 47	Insolation, definition; J. BUCKNELL: Climatology; Ch. 1, p. 1; MACMILLAN; 1964; £0.90; 162 pp.
RL 48	Thorough coverage; E. GATES: Meteorology and Climatology for Sixth Forms; Ch. 2-10; HARRAP; 225 pp.
RL 49	Basic coverage; R. K. GRESSWELL: Physical Geography; Ch. 2-11; LONGMANS; 1967; 500 pp.
RL 50	Understanding earth/sun relationships; Heating & Cooling Relationship of the Earth's Surface; 5960; ENCL. BRIT: £5.50 for set of 8 study prints of which this is one.
RL 51	Factors affecting solar radiation and terrestrial radiation; The Heat Budget of the Earth; 37230; SOUND SERVICES; £5.00; loop; Stand. 8; colour

Section 1.2.3	Weather Systems, Air Masses and Climate
RL 24	A. AUSTIN MILLER & M. PARRY (see RL 24 above).
RL 37	N. HORROCKS (see RL 37 above).
RL 38	F. J. MONKHOUSE (see RL 38 above).
RL 39	O. G. SUTTON (see RL 39 above).
RL 40	F. K. HARE (see RL 40 above).
RL 41	SELBY (see RL 41 above).
RL 46	J. GENTILLI (see RL 46 above).
RL 47	J. BUCKNELL (see RL 47 above).
RL 48	E. GATES (see RL 48 above).
RL 49	R. K. GRESSWELL (see RL 49 above).
RL 52	Factors of climate and climate regions; A. MILLER; Climatology; METHUEN; 1961; £1.50; 306 pp.
RL 53	Variability of climate figures; W. G. KENDREW: Climates of the Continents; appendices of climatic figures to each chapter show variability; OXFORD;OUP
RL 54	General reading; G. MANLEY: Climate and the British Scene; FONTANA; £0.60; 380 pp.
RL 55	Unreliability of rainfall; H. ADDISON; Land, Water and Food; CHAPMAN & HALL; 1961; £1.25; 184 pp.
RL 56	Relationships between surface temperature, pressure and winds; The Development of Sea Breezes; 37231; SOUND SERVICES; £5.00; 4 mins; loop; Stand. 8; colour.
RL 57	Link between pressure changes and temperature - dry and saturated adiabatic lapse rates; The Origin and Characteristics of Föhn Winds; 37232; SOUND SERVICES; £4.50; 4 mins; loop; Stand. 8; colour.

RL 58	Cumulus clouds to demonstrate Bergeron process of rain formation; Formation of Rain; 37234; SOUND SERVICES; £4.50; 4 mins; loop; Stand. 8; colour.
RL 59	Upper wind behaviour; The Formation of Surface High and Low Pressure Systems; 37233; SOUND SERVICES; £4.50; 4 mins; loop; Stand. 8; colour.
RL 60	Prints - Thermometers, Precipitation Gauges, Barometers from The Earth and its Atmosphere; print set (23 weather instruments); ENCL. BRIT: £3.37½ (for full set of 6).
RL 61	Climatic Graphs; PIC 365; JOHN KING Ltd., BRIGHTON; £9.75; strip; B&W.
RL 62	Work of Weather; PIC 231; JOHN KING Ltd., BRIGHTON; £0.75; strip; B&W.

Section 1, 2, 4 Water Cycle

RL 46	J. GENTILLI (see RL 46 above).
RL 55	H. ADDISON (see RL 55 above).
RL 63	General information on water; R. FURON: The Problem of Water - a World Study; FABER, 1963; £2.10; 206 pp.
RL 64	Water Cycle; SPENCER & THOMAS: Cultural Geography; Ch. 8, p. 354 ff; WILEY & SONS; 570 pp.
RL 65	Water cycle; H. L. PENMAN; Sc. Amer. Sept. 1970; pp. 98-108; FREEMAN offprint.
RL 66	Water cycle; M. OVERMAN: Water - Science and Technology Series; Ch. 2; ALDUS.
RL 67	Water Cycle; J. B. RIGG; Textbook of Environmental Study; CONSTABLE; £2.25; 298 pp.
RL 69	Influence of temperature (tropics/polar), salinity (proximity to freshwater estuaries) and turbidity (river discharge) on oceanic currents; Density Currents; 85.013 EALING SCIENTIFIC; 3½ mins; loop; Super 8; colour; £5.37½.
RL 70	Properties of water, the Water Cycle, useful statistics re industrial and agricultural use; Water; ICI; free; 22 mins; 16 mm. film; colour.
RL 71	Water; CGA 731; JOHN KING, Ltd., BRIGHTON.
RL 72	Water for the Community; EB 9104; JOHN KING, Ltd., BRIGHTON.
RL 73	Set 30 The Sea, from the Earth and its Atmosphere; colour prints; £3.37½; ENCL. BRIT.

Section 1, 3 THE LITHOSPHERE

RL 38	Soil types; MONKHOUSE (see RL 38 above), Chs. 1, 2, 3, 4, 5.
RL 49	Weathering slops development; GRESSWELL (see RL 49 above), Chs. 12, 13, 14.
RL 74	Earth structure, energy flow, etc., formation of rocks, weathering, land forms (useful glossary); M. J. SELBY; The Surface of the Earth; Vol. 1; Chs. 1, 2, 3, 4, 5, 7, 15; CASSELL, 1967; £2.25; 268 pp.

RL 75 Weathering, slope development, rocks and relief; B. W. SPARKS: Geomorphology; Chs. 3,4,7; LONGMANS, 1967; 500 pp.

RL 76 As RL 75; H. ROBINSON; Morphology and Landscape; Chs. 1,2,3,4,5,7,9,10; UTP; 1969; £1.50; 390 pp.

RL 77 A. HOLMES; Principles of Physical Geology; general very advanced reference; NELSON, 1960; 1288 pp.

RL 78 Weathering, mass movement, rock type and movement; K. E. SAWYER; Landscape Studies; A1,A2, E. ARNOLD; £2.00; 150 pp.

RL 79 Weathering; G. DURY; The Face of the Earth; Ch. 2,5,6; PENGUIN, 1966; 238 pp.

RL 80 General, very good; R.K. GRESSWELL; Geology for Geographers; HULTON, Educ. Publ; 1963; 200 pp.

RL 81 Formation of sedimentary layers, examples of sedimentary rocks; Sedimentation; 85.0149; EALING SCIENTIFIC; 3¼ mins; £5.37½; loop; Super 8; colour.

RL 82 Description of formation of new land by sedimentation, energy content of stream/river flow in relation to deposition; Alluvial Fan and Delta; 85.0040; EALING SCIENTIFIC; 3¾ mins; £5.37½; loop; Super 8; colour.

RL 83 Useful geological time-scale information; Grand Canyon - Record of the Past; P85-0263/1; Geological Formation; P85-0271/1; (2 loops) £5.37½ each; 4 mins. each; loops; Super 8; colour.

RL 84 Summarizes sea faults, trench, plain, plateau, mountains, seas, islands; Tectonic Movements; GC/4; SOUND SERVICES; £4.50; 4 mins; loop; Stand. 8; colour.

RL 85 Animated explanation of principles; The Formation of Oil; GSO/625; SOUND SERVICES; £3.30; 4 mins; loop; Super 8; colour.

RL 86 Introductory treatment; Vulcanism; P85-0180/1; EALING SCIENTIFIC; £5.37½; 2¾ mins; loop; Super 8; col.

RL 87 Resources for man; Minerals and Rocks; 21.7192; RANK FILM LIB; £2 hire; 15 mins; 16 mm; colour.

RL 88 Rocks including salt, anhydrite limestone, etc. formation - their yield of valuable reeources; Treasure Trove; ICI; free; 18 mins; 16 mm; B&W.

RL 89 Volcanic activity - evidence of internal unrest - Sheet 2 of print set The Earth and its Atmosphere; Set 22; ENC. BRIT. £3.37½ for set of 6 incl. this title.

RL 90 Man's relationship to natural resources - the limited nature of latter; influence of exploitation on pattern of life; Rocks, Minerals and Mining (series) -1) Mining Town; 2) Rocks & Minerals; 3) Natural Gas; 4) Copper; 5) Aluminium; 6) Uranium; 11170; ENC. BRIT; £9.00 for set; strips; colour.

RL 91 Historical Geology of the British Isles; CGA 819; JOHN KING Ltd; Brighton; £2.00; strip; colour.

RL.92 Earth Movements from print set The Earth and its Atmosphere; 1) Crustal folding; 2) A recumbent Anticline; 3) Reverse and Thrust Faulting; 4) Effects of Faulting; 5) Earthquakes; 6) Landslides; Set 32; 1A 32; ENC. BRIT; £3.37½; colour.

Section 1.3.1	**The Soil**
RL 37	Soils and soil erosion and conservation; HORROCKS (see RL 37 above); Ch. 16 part 5.
RL 41	Soil - complete coverage; SELBY (see RL 41 above); Chs. 19-35.
RL 74	Soil erosion; SELBY (see RL 74 above) Ch. 7.
RL 93	General; J. RUSSELL; The World of the Soil; FONTANA 1970; £0.60; 284 pp.
RL 94	Very detailed; B. BUNTING; The Geography of Soil; HUL; £0.75; 200 pp.
RL 95	Very detailed; S.R. EYRE; Vegetation and Soils; ARNOLD; 1970; £2.75; 300 pp.
RL 96	Weathering, soil profiles - very good; E.M. BRIDGES; World Soils; CUP 1970; 100 pp.
RL 97	G.V. JACKS; Soil; NELSON £1.50; 220 pp.
RL 98	Old, but useful outline of crop requirements, nature of soil, etc; Factors of Soil Fertility; ICI; free; 16 mm. 20 mins; B&W.
RL 99	Old; rel. - nutrient flow through crops/livestock/soil; deficiency symptoms; Soil Nutrients; ICI; free; 16 mm. film; 20 mins; B&W.
RL 100	Causes and effects of soil erosion in Australia; Look to the Land; PETROLEUM FILM BOARD; free; 16 mm. film; 15 mins; B&W.
RL 101	A Soil Association film presenting the conflict associated with the removal of hedgerows in English land use; The Secret Highway; price ? SOUND SERVICES; 30 mins; 16 mm. film; colour.
RL 102	An examination of soil structure and its productivity, followed by an analysis of pressing problems of soil conservation; Soil Conservation SERIES; 1) How long will it last? 2) How soil is formed; 3) Plant life and the Soil; 4) Water and the Soil; 5) Animal life and the Soil; 6) Minerals in the Soil; 7) How man has used the Soil; 8) How Man conserves the Soil; 7360; ENC. BRIT. £7 for set or £1 each strip; B&W.
RL 103	Weathering and Erosion; Ep 6490; JOHN KING, BRIGHTON; £1.18; strip; colour.
RL 104	Soil Parts 1 and 2; CGA 374/375; JOHN KING, BRIGHTON; £1.10; strip; B&W.
RL 195	Saving our Soil; EB 9092; JOHN KING, BRIGHTON; strip; colour.
Section 1.4	**THE BIOSPHERE**
RL 65	Origin and nature of life, the biosphere; (see RL 65 above) p. 45.
RL 106	Life and problems in different realms; A.E. VINES & N. REES; Plant and Animal Biology, Vol. 2; p. 120-177; PITMAN, 1964; £2; 826 pp.
RL 107	A set of loops that re-enacts in the lab. events which must have occurred on primitive earth; a recreation of possible steps in the origin of first life; Origin of Life series; 1) From primitive gases to amino-acids; 2) From amino-acids to proteinoids; 3) From proteinoids

to micro-spheres; 4) Cell-like characteristics of micro-spheres; 5) The primitive earth (excellent, highly recommended); 89-9799/1; EALING SCIENTIFIC; £26.75 for set or £5.37½ each; 3¾ mins. each; loops; Super 8; colour.

Section 1.4.1 Conception of the Circulation of Elements

RL 65 Cycles (see RL 65 above).

RL 106 Nitrogen cycle; VINES and REES (see RL 106 above) p. 271-2

RL 108 Phosphorus, carbon and nitrogen cycles; R. M. JACKSON; Life in the Soil; p. 49; ARNOLD; 1966; 59 pp.

RL 99 (see RL 99 above).

RL 109 Circulation of gas molecules in a pond- anatomical modifications for respiration (skin, gills, surface and bubble breathing); How Animals Breathe (Freshwater); R1-319; EALING SCIENTIFIC; loop; £5.37½; 4½ mins; Super 8; colour.

RL 110 Experimental investigation of fluctuation in oxygen levels in a lake containing algae (oxygen cycle); Oxygen Levels during an Algal Bloom; 81-6538; EALING SCIENTIFIC; £5.37½; 3½ mins; loop; Super 8; colour;

RL 111 The Food (Carbon) Cycle; CGA 293; JOHN KING Films, Ltd; Brighton; £1.20; strip; B&W.

RL 112 The Food (Nitrogen) Cycle; CGA 664; JOHN KING Films Ltd; Brighton; £1.20; strip; B&W.

RL 116 Nuffield A level Biol. Science, p. 4.

Section 1.4.2 Methods of Obtaining Energy

RL 113 Autotrophic and heterotrophic; Nuffield A level Biol. Sc; Organisms and Populations; p. 114; PENGUIN, 1970; 142 pp.

RL 114 Autotrophic and heterotrophic nutrition; K. REED; Nature's Network - Interdependence in Nature; p. 31; ALDUS, 1969; £1.80; 187 pp.

RL 115 Photosynthesis; Topic Review - Photosynthesis; PENGUIN, 1970; 16 pp.

RL 116 Nuffield A level Biol. Science - Maintenance of Organisms; Ch. 7, p. 118; PENGUIN, 1970; 153 pp.

RL 117 Nuffield O level Biol. III - Ch. 8, p. 131; PENGUIN, 1966; 238 pp.

RL 118 Nuffield A level Biol. Science Study Guide (Evidence & deduction in biological science); Ch. 7, p. 86; PENGUIN 1970; 472 pp.

RL 119 Photosynthesis and respiration; A. L. LEHNINGER; How cells Transform Energy (sc. Amer. Offprint No. 69); FREEMAN, 1961; 13 pp.

RL 120 Anabolism and katabolism; F. C. STEWARD; Plants at Work; Ch. 5; p. 43; Chs. 6 and 7, p. 46; ADDISON & WESLEY, 1967; 184 pp.

RL 121 Dissection of the rat; H. G. Q. ROWETT; Dissection Guides III - The Rat; MURRAY; 64 pp.

RL 122	Homeostasis: D.P. BENNETT and D.A. HUMPHRIES; Introduction to Field Biology; pp.9 and 10; ARNOLD; 1965; 197 pp.
RL 106	Adaptations for obtaining food; p.310.
RL 117	(see RL 117 above); Foods; p.47; Determination of calorific values, p.57.
RL 123	J. PHILLIPSON; Ecological Energetics; p.48; ARNOLD, 1966; 57 pp.
RL 124	Cattle conversion rates; MIN. OF AGRICULTURE; Rations for Livestock; HMSO.
RL 125	Measuring photosynthetic rates; C.K. RAWLINS; School Science Review, Vol.51, No.177; p.853; MURRAY, 1970.
RL 126	Entropy energy transference; NUFFIELD A level Biol. Science - Topic Review - Metabolism; PENGUIN, 1970, 36 pp.
RL 118	(see RL 118 above). Energy Conversion, p.223.
RL 116	(see RL 116 above). Breathing and energy, p.15.
RL 118	(see RL 118 above). Breathing and energy, p.22.
RL 117	(see RL 117 above). Absorption spectrum, p.146.
RL 116	(see RL 116 above). Photosynthesis and tracer techniques; Ch.7, p.118.
RL 118	(see RL 118 above). Photosynthesis and tracer techniques; Ch.7, p.86.
RL 117	(see RL 117 above). Compensation point and photosynthesis, Ch.7, p.112; Respiration, how energy is obtained, Ch.3, p.32.
RL 127	Introductory note: Carnivorous, piscivorous and omnivorous animals; Comparison of Teeth in Mammals; BGD/614; SOUND SERVICES; £3.45; Stand. 8; loop; colour.
RL 128	Elodea - leaf structure, individual cell structure, chloroplasts, etc; The Structure of a Green Plant; BB/281; SOUND SERVICES; £3.30; loop; Super 8; col.
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RL 149 Study of social animal; Baboons; 81-8864/1; EALING SCIENTIFIC; £6.37½; loop; Super 8; colour.

RL 150 Fundamental nature of photosynthesis, introduction to principle of heterotrophic nutrition, outline of human digestion, interdependence of plants and animals; Photosynthesis and Muscular Energy; Ref. 145; GATEWAY EDUCATIONAL FILMS Ltd., £50.00; hire per day £2.50; 13 mins. 1½ reels; 16 mm. film; colour.

RL 151 (Excellent introduction to Sect. 3); animals nearest to man; Family Portrait; BFI; Price ?; 16 mm, film; 35 mins; B&W.

RL 152 Heterotrophic nutrition; No Holds Barred; BFI; Price ?; 25 mins; 16 mm. film; B&W.

RL 153 Industrial pollution, industrial Melanism, experimental design in population work; Evolution in Progress; BFI; Price ?; SILENT; 16 mm. film; colour; adequate written commentary.

RL 154 Cell as factory, structure of proteins, function of genetic code; The Structure of Proteins; UNILEVER; free; 16 mm. and 35 mm. film; colour; 17 mins.

RL 155 Basic heterotrophic organism and food source for man - early weaning as a means of increasing yield (superficial relevance); Nutrition & the Pig; UNILEVER; free; 16 mm; colour; 15 mins.

RL 156 Good account of food-hunting activities, principle of over-production and population control, intervention of man (bird pest control), spray drift, effects on bird populations; Survival - The Only Pretty Ring Time; BFI; £0.50 per day hire; 16 mm. B&W; 20 mins.

RL 157 Study of typical herbivores; excellent historical outline of deer populations in England; Survival - The Unprotected Deer; BFI; £0.50 hire per day; 16 mm; 20 mins; B&W.

RL 158 What is Nutrition?; C119; JOHN KING Ltd, Brighton; £1.75; strip; colour.

RL 159 Food and Health; CGA 76; JOHN KING Ltd, Brighton; £1.12½; strip; B&W

RL 160 Carbohydrates and Calories; CGA 81; JOHN KING Ltd, Brighton; £1.12½; strip; B&W.

RL 161 Fats and Proteins; CGA 93; JOHN KING Ltd, Brighton; £1.12½; strip; B&W.

RL 162 Vitamins and Mineral Salts; CGA 112; JOHN KING Ltd, Brighton; £1.12½; strip; B&W.

RL 163 Food Storage in Plants; PIC 346; JOHN KING Ltd, Brighton; £0.75; strip; B&W.

RL 164 Feeding and Digestion in Mammals; CGA 221; JOHN KING Ltd, Brighton; £1.12½; strip; B&W.

RL 165 Plant and Animal Relationships; series Strips 1-5; (see RL 194, section 2.6 below).

Section 2 THE ECOSYSTEM

RL 165 Field work ideas - general ecology and field techniques; C.T. PRIME, Investigations in Woodland Ecology; HEINEMANN, 1970, 47 pp.

RL 122 General Ecology and Field techniques; D.P. BENNETT and D.A. HUMPHRIES; Introduction to Field Biology.

RL 166	General ecology and field techniques; J. SANKEY; A Guide to Field Biology; LONGMAN 1958; £0.90; 166 pp.
RL 167	General ecology and field techniques; T.R. SOUTHWOOD; Ecological Methods; CHAPMAN & HALL, 1966; £3.75.
RL 168	General ecology and field techniques; W.H. DOWDESWELL; An Introduction to Animal Ecology; METHUEN 1959; 209 pp.
RL 108	General ecology and field techniques; JACKSON (see RL 108 above), Ch. 3, p. 28.
RL 169	General ecology and field techniques; M. ASHBY; Introduction to Plant Ecology; MACMILLAN 1969; £2.75; 287 pp.
RL 170	General ecology and field techniques; NUFFIELD O level Biol, Text IV.
RL 116	Concentration of oxygen in pond water; NUFFIELD A level Biol. Science Maintenance of the Organism; p.4; PENGUIN, 1966; 313 pp.
RL 171	Illustration of a community - physical factors and interrelations between organisms; Introduction to the Coral Reef; 81-3204/1; EALING SCIENTIFIC; £5.37½; 4½ mins; loop; Super 8; colour.
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Section 2,1	CLIMATIC AND EDAPHIC FACTORS
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RL 122	BENNETT and HUMPHRIES (see RL 122 above).
RL 166	SANKEY (see RL 166 above).
RL 167	SOUTHWOOD (see RL 167 above).
RL 168	DOWDESWELL (see RL 168 above).
RL 108	JACKSON (see RL 108 above).
RL 169	ASHBY (see RL 169 above).
RL 170	(see RL 170 above).
RL 116	(see RL 116 above).
RL 133	(see RL 133 above).
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RL 175	Good general information re various roles of water in biosphere; Water in Biology; UNILEVER; free; 22 mins; 16 mm; colour.
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RL 175b	The Living Environment; 21.7499; RANK FILM LIB; £1.25 per day hire; 8 mins; 16 mm; colour.

GENERAL BOOKS

RL 195	Identification of Organisms; Pocket & Field Guide Series; COLLINS.
RL 198	Identification of Organisms; Wayside & Woodland Series; WARNE.
RL 197	Identification of Organisms; Scholarship Series in Biology; HEINEMANN.
RL 198	Identification of Organisms; Oxford Book of Flowerless Plants; OUP.
RL 199	Identification of Organisms; E. F. DAGLISH: Name This Insect; DENT; 294 pp.
RL 200	Identification of Organisms; H. MELLANBY; Animal Life in Freshwater; METHUEN; 250 pp.
RL 201	Identification of Organisms; Dictionary of Biological Terms; PENGUIN; £0.50; 100 pp.
RL 202	General guide for non-specialists; A. LEUTSCHER; Field Natural History; BELL, 1969; £3.00; 248 pp.

Section 2,2 PYRAMIDS OF NUMBERS

RL 178	Pyramid of numbers and food webs; E. G. NEAL; Woodland Ecology; Ch. VIII, p. 54; HEINEMANN, 1958; 116 pp.
RL 123	Pyramid of numbers and food webs; PHILLIPSON (see RL 123 above), Ch. 2, p. 8.
RL 118	Pyramid of numbers and food webs; (see RL 118 above) p. 217.
RL 177	E. P. ODUM; Fundamentals of Animal Ecology; p. 59; SAUNDERS, 1971; 546 pp.
RL 178	Diversity of forms - survival struggle - biological pressures on populations, etc; Darwin and the Insects of Brazil; PFB; free; 34 mins; 16 mm. colour.
RL 141	(see RL 141 above).

Section 2,3 FOOD WEBS

RL 178	NEAL (see RL 178 above).
RL 123	PHILLIPSON (see RL 123 above).
RL 118	(see RL 118 above).
RL 177	ODUM (see RL 177 above).
RL 113	Food Webs (see RL 113 above) Ch. 8, p. 114.
RL 118	Flow of energy (see RL 118 above) Ch. 8, p. 98.
RL 177	Primary production values (ODUM, see RL 177 above) Ch. 3, p. 88.
RL 123	Decomposers; PHILLIPSON (see RL 123 above).
RL 179	Biological control; H. G. ANDREWARTHA; Introduction to the Study of Animal Populations; p. 80; METHUEN, 1970; 283 pp.
RL 180	Parasites and hyperparasites; G. ORDISH; Biological Methods in Crop Pest Control; p. 45 and p. 155; CONSTABLE, 1967.
RL 181	Whitefly Control; MIN. OF AGRICULTURE; Beneficial Insects & Mites; p. 98; HMSO, 1969; £0.85; 118 pp.
RL 182	The Everglades: Food Web; 81-7213/1; EALING SCIENTIFIC; loop; Super 8; colour.

RL 183 — Mangrove Swamp: Food Web; 81-7247/1; EALING SCIENTIFIC; loop; Super 8; colour.

RL 184 — Pond - Food Web; 81-7288/1; EALING SCIENTIFIC; loop; Super 8; colour.

RL 185 — Diatoms in a Food Web; 81-6553/1; EALING SCIENTIFIC; loop; Super 8; colour.

RL 141 — (see RL 141 above).

RL 136 — (see RL 136 above).

RL 140 — (see RL 140 above).

RL 147 — (see RL 147 above).

RL 187 — (see RL 156).

RL 188 — The Living Pattern; PFB; free loan; 16 mm; 30 mins; colour.

RL 152 — (see RL 152).

Section 2.4 ECOLOGY OF POPULATION

RL 189 — Population growth and regulation; M. E. SOLOMON; Population Dynamics; pp. 16 & 35; ARNOLD, 1969; 59 pp; Competition, p. 37; Predators, pp. 35 & 48.

Section 2.5 POPULATION, CONTROL MECHANISMS

RL 189 — Cycles of abundance; SOLOMON (see RL 189 above), p. 16. Reproductive capacity; pp. 8 & 13.

RL 181 — Aphis (see RL 181 above), p. 75. Red Spider, p. 51.

RL 141 — (see RL 141 above).

RL 142 — (see RL 142 above).

RL 156 — (see RL 156 above).

RL 191 — Population counting in a National Park, effects of imbalance (hippos) and consequent control; related lab. experiments; impact of primitive fishing tribe; general management of National Park; Survival - Elephants have Right of Way; BFI (Anglia ITV); 16 mm; B&W.

Section 2.6 ECOLOGY OF COMMUNITIES

RL 177 — Succession in ecosystems; ODUM (see RL 177 above) Ch. 8, p. 245.

RL 114 — Succession in ecosystems; REED (see RL 114 above) Ch. 8, p. 115.

RL 192 — Effects of sheep on chalkland; T. C. E. WELLS; Biological Aspects of Conservation Management of Chalk Grasslands; THE NATURE CONSERVANCY; 6 pp.

RL 193 — Bog: Succession; 81-7312/1; EALING SCIENTIFIC; loop; Super 8; colour.

RL 194 — Excellent series 'Plant and Animal Relationships' - 1) The Grassland: Story of a Major Community; 2) The Swamp: Some Relationships between Organisms; 3) The Desert: An example of Adaptation; 4) The Seashore: A Continually Changing Environment; 5) The Pond: How Living Things change their Environment; 6) The Forest: A Stable Community; 10796; ENC. BRIT. £1.75 each strip or £9.00 for box of 6; 45 frames per strip; colour.

Section 3	THE INTERACTION OF MAN AND THE ENVIRONMENT
Section 3.1	MAN AS A HETEROTROPHIC ORGANISM
RL 505	ARTHUR, D.R; Survival - Man and his Environment; ENG. U.P; £1.40; 218 pp.
RL 509	LAUGHLIN, W.S. and OSBORNE, R.H; Human Variation and Origins (Readings from Scientific American); FREEMAN, 1967; £2.10; 297 pp.
RL 510	NAPIER, J; Evolution of the Hand; Scientific American offprint No.140; 1967, £0.10; 10 pp.
Section 3.1.1	The Satisfaction of his Fundamental Requirements
RL 502	STAMP, D; Man and his Environment; SCIENCE JOURNAL, May 1965.
RL 503	STAMP, D; Geography of Life and Death; COLLINS, 1964; 30p; 160 pp.
RL 507	WELLS, C; Bones, Bodies and Disease; THAMES & HUDSON, 1964; £2.50; 248 pp.
RL 508	BROTHWELL, R; Food in Antiquity; THAMES & HUDSON, 1969; £2.50; 248 pp.
RL 511	BRESLER, J.B. Environments of Man: Reading/Mase; ADDISON-WESLEY, 1967; 285 pp.
Section 3.2	THE EVOLUTION OF MODERN MAN AS A TOOL-USING, RATIONAL CREATURE
RL 506	WASHBURN, S.L; Toole and Human Evolution; SCIENTIFIC AMERICAN offprint No.601; Sept. 1960.
RL 513	OAKLEY, K.P; Man the Toolmaker; BRITISH MUS.
Section 3.2.1	A consideration of Hunter, Pastoral and Agricultural Societies
RL 501	FORDE, D; Habitat, Economy and Society; METHUEN, 1970; 500 pp.
RL 516	Ecology of Man in Britain; FLEURE & DAVIS; Natural History of Man in Britain; Fontana; 1971; 75 pp.
RL 517	Specific Problems of Ecology of Man in Britain; DARBY, H.C; Historical Geography of England; CAMBRIDGE; CUP; 1969; £3; 566 pp.
RL 639	Early Food Producing Population; DARLING (eee RL 639 below) pp. 134-152.
RL 519	Background to early settlement - Britain; JESSUP, Ancient People and Places, South East England; THAMES & HUDSON; 1970; £2.50.
RL 520	CHADWICK, N; Celtic Britain; THAMES & HUDSON, 1963; £2.50.
RL 521	CLARKE, R; East Anglia; THAMES & HUDSON.
RL 522	STONE, J; Wessex before the Celts; THAMES & HUDSON; 1958; £2.50.

Hunters

RL 515 Critical population, statistics of hunters and gatherers; ALLAN, W; The African Husbandman; Chapter XVI; Edinburgh & London; OLIVER & BOYD; 1964; 474pp.

RL 523 Hunters; LAUWERYS, J.A; man the hunter in Man's Impact on Nature; Ch.III; London; ALDUS; 1969; £1.80; 186 pp.

RL 524 Pygmies; TURNBULL, C; Wayward Servants; EYRE & SPOTTISWOOD; £1.25. TURNBULL, C; Lesson of the Pygmies; New York; SCIENTIFIC AMERICAN offprint 615.

RL 529 The Hadza; BRITISH MUSEUM; The Material Culture of the Hadza; BRITISH MUSEUM; 1970.

RL 531 Waiwai (Amazon Rain Forest); YDES, J; Material Culture of the Waiwai; Copenhagen; NATIONAL MUSEUM; 1965; 318 pp.

RL 532 Waiwai (Amazon Rain Forest); FOCK, N; Waiwai; religion and society of an Amazon tribe; Copenhagen; NATIONAL MUSEUM; 1963.

RL 534 Australian Aborigines; BERNDT, R.M. and BERNDT, C.M. (eds); Aboriginal Man in Australia; Essays in honour of Emeritus Professor A.P. Elkin; ANGUS & ROBERTSON; 1965; 491 pp.

RL 535 Australian Aborigines; BIRDSELL, J.B; Some environmental and cultural factors influencing the structuring of Australian Aboriginal Populations in Bresler, J.B. Human Ecology; pp.51-90; reading mass; ADDISON-WESLEY; 1961.
Film: Peoples of the Australian Western Desert Pt.1 and 2 Desert People; BRITISH FILM INDUSTRY; Hire £5; 51 mins; 16 mm. B&W.

RL 530 The Hadza - film of hunting and gathering activities; The Hadza; BRITISH FILM INSTITUTE; Hire £4; 40 mins; 16 mm. B&W.

RL 536 Australian Aborigines; Film: Kangaroo Meal; DIANA WYLLIE; £2; c.3 mins; 8 mm. loop.

RL 533 Yanomama Indians: Hunting, gathering and other activities; Film: Indians of the Orinoco Jungle 870063, 870071; 870089, 870113, 870127, 870139; DIANA WYLLIE; Sale £2 each; c.3 mins; loops 8 mm.

Pastoralists

RL 515 Carrying Capacity of Lands under Pastoral Economics; ALLAN, W; African Husbandman; Ch. XVII.

RL 523 General: LAUWERYS, J.A; Man and the herdsman in Man's Impact on Nature; Ch.4; LONDON, ALDUS; 1969; £1.80; 186 pp.

RL 639 Ecology of Pastoral Systems: DARLING, F. FRAZER; 'Man's ecological dominance through domesticated animals on wild lands' in Man's Role in Changing the Face of the Earth Vol. 2; pp.778-787; CHICAGO; PHOENIX BOOKS, UNIVERSITY OF CHICAGO; 1970; 700 pp.

RL 538 Selection of Articles: LEEDS, A. and VAYDA, A.P. (eds.); Man Culture and Animals; WASHINGTON, D.C. American Association for the Advancement of Science Publication No. 78; 1965.

RL 539 The Jie of Uganda; GULLIVER, P.H; The Family Herds; 1965.

RL 540 The Jie of Uganda; GULIVER, P.H; The Jie of Uganda in Peoples of Africa, Gibbs, J.L; pp. 157-195; New York, HOLT, REINHART & WINSTON; 1965: 594 pp.

RL 541 Pastoral Fulani (West Africa); STENNING, D.J; Savanna Nomads; Oxford; OUP; 1959

RL 542 Pastoral Fulani (West Africa); STENNING, D.J; Pastoral Fulani of Northern Nigeria in GIBBS, J.L. Jr. Peoples of Africa; pp. 361-401; New York: Holt, Reinhart & Winston: 1965; 594 pp.

RL 543 Pastoral Fulani (West Africa); STENNING, D.J; Transhumance, migratory drift and migration; JOURNAL OF THE ROYAL ANTHROPOLOGICAL INST. No. 87.

RL 544 Persian Nomads; BARTH, F; Nomads of South Persia; ALLEN & UNWIN; 1961.

RL 545 Karimojond Uganda; DYSON-HUDSON R & N; Subsistence Herding in Uganda; Scientific American offprint No. 641; 1969.

Cultivators

RL 515 General background - includee techniques for calculating critical population statistics; ALLAN, W; African Husbandman; OLIVER & BOYD; 1964.

RL 546 Chitemene Cultivators in Central Africa; RICHARDS, A.I; Land Labour and Diet in Northern Rhodesia: An Economic Study of the Bemba Tribe.

RL 547 Chitemene Cultivators in Central Africa; KAY, G; Chief Kalaba's Village; RHODES - LIVINGSTONE PAPERS No. 35; MANCHESTER UNIVERSITY PRESS; 1964; 97 pp.

RL 548 Shifting Cultivators in the Philippines; CONKLIN, H; Hanunoo Agriculture; a report on an integral system of shifting cultivation in the Philippines; Rome; FAO Forestry Development Papers No. 12; 1957; 209 pp.

RL 549 Cultivation in New Guinea Highlands - Chimbu; BROOKFIELD, A. and BROWN, P; Struggle for Land: Agriculture and Group Territories among Chimbu of New Guinea Highlands; Oxford; OUP; 1963; 188 pp.

Section 3.2.2 Man's Domestication of Plants and Animals

RL 552 Domestication; ZEUNER, F.E; The Cultivation of Plants in SINGER, C. et al. History of Technology Vol. 1; pp. 353-75; Oxford; CLARENDON; 1954;827pp.

RL 639 ANDERSON, E; Man as a maker of new plants and new plant communitiee in Man's role in changing the face of the earth; THOMAS, W.L. Jr. (ed.) Vol. 2; pp. 763-777; Chicago; PHOENIX BOOKS, University of Chicago; 1970; 700 pp.

RL 554 SAUER, C.O; Agricultural origins and dispersals; MIT; 1969; 165 pp.

RL 555 COLE, S; Neolithic Revolution; BRITISH MUSEUM; £0.50; 50 pp.

RL 639 DARLING, F. FRAZER: 'Man's Ecological Dominance through Domestic Animals on Wild Land' in THOMAS, W.L. Jr. Man's Role in Changing the Face of the Earth Vol.2; pp. 778-787; Chicago; PHOENIX BOOKS, UNIVERSITY OF CHICAGO; 1970; 700 pp.

RL 557 MANGELSDORF, P.C. Wheat: SCIENTIFIC AMERICAN offprint No.25.

RL 558 MANGELSDORF, P.C. The Mystery of Maize: SCIENTIFIC AMERICAN offprint No.26.

RL 523 Domestication; LAUWERYS, J.A; Man the Cultivator in Man's Impact on Nature; Ch.5; ALDUS; 1969; £1.80; 188 pp.

RL 560 BRAIDWOOD, R.J; Agricultural Revolution; SCIENTIFIC AMERICAN offprint No.605; 1970.

RL 561 UCKO, J. and DIMBLEBY, G.W; The Domestication and Exploitation of Plants and Animals; DUCKWORTH; £7.07.

RL 562 ISAAC, E; Geography of Domestication; Englewood Cliffs; PRENTICE HALL; 1970; 132 pp.

RL 563 Genetics: MACKEAN, D.G; Introduction to Genetics; Ch.2; MURRAY; 1968; 37½p; 37 pp.

Section 3,2,3 Man's Use of Mineral Resources

RL 639 McLAUGHLIN, D.H; Man's Selective Attack on Ores and Minerals in THOMAS, W.L. Jr. Man's Role in Changing the Face of the Earth Vol.2; pp.851-61; PHOENIX, UNIVERSITY OF CHICAGO; 1970; 700 pp.

RL 565 STREET, A. and ALEXANDER, W; Metals in the Service of Man; PENGUIN; 35p.

RL 566 ECONOMIST INTELLIGENCE UNIT Oxford Economic Atlas of the World; 1965; £3.15; 285 pp.

Section 3,2,4 Man's Acquisition of Energy Exploiting Techniques and Their Application to his Evolutionary Success

RL 639 Fuels; AYRES, E; The age of fossil fuels in THOMAS, W.L. Jr. Man's Role in Changing the Face of the Earth Vol.1; pp.367-380; CHICAGO, PHOENIX, UNIVERSITY OF CHICAGO; 1970; 448 pp.

RL 567 SIMPSON, E.J; Coal and the Power Industries in Post War Britain; LONGMANS; 1966; 90p; 170 pp.

RL 568 ODELL, P; Economic Geography of Oil; BELL; 1965; £1.12½; 219 pp.

RL 569 CROWE, S; Landscape of Power; ARCHITECTURAL PRESS; 1958; £1; 115 pp.

RL 570 MANNERS, G; The Geography of Energy; HUTCHINSON; 1964; 75p; 205 pp.

RL 571 SCALY, K.R; The Geography of Transport; HUTCHINSON; 1957; 52½p; 202 pp.

RL 564 JARRETT, H.R; Geography of Manufacturing; MACDONALD EVANS; 1969; £1.75; 350 pp.

Section 3.3	PRESSURES ON THE ENVIRONMENT
RL 500	Pressure on the environment; ARVILL, R; Man and the Environment; PENGUIN; 1967; 52½p; 330 pp.
RL 504	NICHOLSON, M; Environmental Revolution; HODDER & STOUGHTON; £4.20; 366 pp.
RL 638	EHRLICH; The Population Bomb; PAN; £0.30; 141 pp.
RL 624	Population Problems Studies of 19 countries; PEP; World Population and Resources; Part II, pp. 107-174; ALLEN & UNWIN; 1962; £1.50.
RL 640	Problems of underdeveloped countries; GOUROU, P; The Tropical World; Ch. 1-3; LONGMANS; 1953; £2; 194 pp.
RL 538	Population: OSBORN, F; Our Crowded Planet; ALLEN & UNWIN; 1962; 188 pp.
RL 626	Future of world resources: NATIONAL ACADEMY OF SCIENCES; Resources and Man; a study and recommendation on Resources and Man by the Division of Earth Sciences; FREEMAN; 1969; £1.20; 259 pp.
RL 630	Human Life. Environment; FAIRBROTHER, N; New Lives, New Landscapes; ARCHITECTURAL PRESS; 1970; £3.75.
Section 3.3.1	Reproductive Capacity and Population Explosion in Underdeveloped Countries
RL 500	Pressure on Environment; ARVILL, R; Man and the Environment; PENGUIN; 1967; 52½p; 330 pp.
RL 638	Population Problems; EHRLICH; The Population Bomb.
RL 624	Population Problems; studies of 19 countries.
RL 641	PADMINI SENGUPTA; Life in Urban Industrial Bengal; WELLINGTON, N.Z; NEW ZEALAND DEPARTMENT OF EDUCATION; 1960; 39 pp.
RL 642	Urban growth in underdeveloped countries; SCIENTIFIC AMERICAN BOOK; Cities; pp. 67-85 Calcutta - a premature metropolis; PENGUIN; £0.37; 1966; 221 pp.
RL 573	Mauritius; CENTRAL OFFICE OF INFORMATION; Mauritius; HMSO; 1968; £0.27; 33 pp.
RL 574	Hong Kong; Hong Kong - the Overcrowded Room; LONGMAN'S OXFAM SERIES.
RL 579	Population; CLARK, C; Population Growth - land use; MACMILLAN; 1967; £4.50; 400 pp.
RL 580	Population; EHRLICH, P.R. and EHRLICH, A.H; Population Resources Environment; FREEMAN; 1970; £4.20; 383 pp.
RL 581	Population; CIPOLLA, C.M; Economic History of World Population; PENGUIN.
RL 582	Population; PARK, C.W; The Population Explosion; HEINEMANN; 1970; 106 pp.
RL 583	Population; OSBORN, F; Our Crowded Planet; ALLEN & UNWIN; 1962; 188 pp.

Section 3.3.2	The Industrial Revolution
RL 575	ASHTON, T.S; Industrial Revolution; OUP 1971; £0.40; 132 pp.
RL 576	Development of an industrialized society in Britain; HOBSBAM
RL 577	Social History of Britain in the 19th Century; BRIGGS, A; Age of Improvement; LONGMANS; £2.50.
RL 578	THOMPSON, E.P; Making of British Working Class; PENGUIN; 1970; £0.75; 100 pp.
Section 3.3.3	Effects on the Environment of Urbanization
RL 584	Development of Cities; MUMFORD, L; City in History; PENGUIN; £1.05; 680 pp.
RL 639	Historical perspective; MUMFORD, L; Man's Role in Changing the Face of the Earth; pp.382-397.
RL 642	Cities; SCIENTIFIC AMERICAN; Cities,
RL 587	Urban History in Britain; DYOS, H.J; The Study of Urban History; ARNOLD; 1968; £5; 400 pp.
RL 588	Urban History in Britain; BRIGGS, A; Victorian Cities PENGUIN; £0.50; 200 pp.
RL 589	HALL, P; London 2000; FABER; £5.00; 400 pp.
RL 590	HALL, P; World Cities; WEIDENFELD & NICOLSON; 1966; £2.50; 200 pp.
RL 600	Traffic and city development; TETLOW & GOSSE; Homes, Town, Traffic; FABER; 1965; £1.00; 270 pp.
RL 602	Town Planning; CULLEN, G; Townscape; ARCHITECTURAL PRESS; 1961; £3.50; 260 pp.
RL 603	Urban Conservation; WORSKETT, R; Character of Towns; ARCHITECTURAL PRESS; 1969; £2.25; 205 pp.
RL 604	Recent development and controversies. Rationale of planning; ROSKILL COMMISSION; The Siting of the Third London Airport; In particular Note of Dissent by C. Buchanan pp.149-160; HMSO; 1971.
RL 605	New Towns in Britain; OSBORN & WHITTICK; New Towns - Answer to Magalopolis; LEONARD HILL; 1969; £8.75; 427 pp.
RL 606	Recent Experience of Planning Problems; WARD, P; Conservation and Development; NEWCASTLE UPON TYNE: ORIEL PRESS; 1968; £3.75; 271 pp.
RL 607	Town and Country Planning; CULLINGWORTH, J.B; Town and Country Planning in England and Wales; ALLEN & UNWIN; 1964; 341 pp.
RL 608	Rural Environment; STAMP, D; Man and the Land; COLLINS; 1955; £1.60; 299 pp.
RL 613	Planning Problems: BRETT, L; Landscape in Distress; Chapter 7; ARCHITECTURAL PRESS; 1963; £2; 155 pp.
RL 615	A US appraisal of British Planning Methods; HANDELKER, D.R; Green Belts and Urban Growth; MADISON, WISCONSIN; UNIVERSITY OF WISCONSIN; 1962; $5; 174 pp.

Section 3.3.4	Mechanization and Intensification of Agriculture
RL 608	Rural Environment; STAMP, D; Man and the Land; Collins; 1955; £1.60; 299 pp.
RL 609	Development of Rural Environment; HOSKINS, W.G; Making of the English Landscape; HODDER & STOUGHTON; £1.75; 238 pp.
RL 610	Developments of Rural Environment; FLEURE AND DAVIES; Natural History of Man in Britain; Collins/Fontana; 1971; 75p. 336 pp.
RL 611	Rural Planning; WELLER, J.D; Modern Agriculture and Rural Planning; ARCHITECTURAL PRESS; £3.50; 440 pp.
RL 612	Special problems of intensive mechanized agriculture; BARBER, D; Farming and wildlife - a study in compromise; Royal Society for the Protection of Birds Publication; 1970; 91 pp.
RL 613	Planning Problems; BRETT, L; Landscape in Distress Ch. 7; ARCHITECTURAL PRESS; 1963; £2; 155 pp.
RL 614	Rural Planning; HACKETT, B; Landscape Planning; NEWCASTLE UPON TYNE; ORIEL PRESS; 1971; £4; 124 pp.
RL 615	A US appraisal of British planning methods; HANDELKER, D.R; Green Belts and Urban Growth; MADISON, WISCONSIN; UNIVERSITY OF WISCONSIN; 1962; $5; 174 pp.
Section 3.3.5	Further Illustrations of Pressures on the Environment Resulting in Degradation
RL 616	Degradation of land; BARR, J; Derelict Britain; PENGUIN; 1969; £0.35; 240 pp.
RL 617	OXENHAM, J.R; Reclaiming Derelict Land; FABER; 1966; £2.10; 198 pp.
RL 618	Dereliction case studies; HILTON, K.J; Lower Swansea Valley Project; LONGMANS; 1967.
RL 619	Degradation of land; COWLEY, G; Bedfordshire Brickfield; BEDFORDSHIRE COUNTY COUNCIL; £0.50; 10pp.
RL 639	Deforestation; THOMAS, W.L; 'Clearing of the Woodlands in Europe' in Man's Role in Changing the Face of the Earth; pp.183-210.
RL 621	Deforestation; MILES, R; Forestry in the English Landscape; FABER; 1967; £5.25; 297 pp.
RL 622	Deforestation; EDLIN, H.L; Trees, Woods and Man; COLLINS; 1956; £2.25; 270 pp.
RL 614	Rural Planning; HACKETT, B; Landscape Planning; NEWCASTLE UPON TYNE; ORIEL PRESS; 1971; £4; 124 pp.
RL 639	Erosion, Salination; THOMAS, H.E; 'Changes in the quantities and qualities of ground surface water' in Man's Role in Changing the Face of the Earth, Vol.II; pp.542-558.
RL 600	Traffic and city development; TETLOW and GOSSE; Homes, Town, Traffic; FABER; 1965; £1; 270 pp.

RL 625 Water Pollution; KLEIN, L; River Pollution; 3 vols; 1962; BUTTERWORTH; £5; 450 pp.

RL 626 Future of world resources; NATIONAL ACADEMY OF SCIENCES; Resources and Man - a study and recommendations on resources and man by the Division of Earth Sciences; FREEMAN; 1969; £1.20; 259 pp.

RL 629 TAYLOR, G.R; The Doomsday Book; THAMES & HUDSON; 1970; £2.00; 400 pp.

RL 628 MELLANBY, K; Pesticides and Pollution; COLLINS/FONTANA; 1967/69; £1.80/40p; 220 pp.

RL 630 Human Life; environment; FAIRBROTHER, N; New Lives, New Landscapes; ARCHITECTURAL PRESS; 1970; £3.75.

RL 511 Irradiation; COMAR, C.L; 'Biological aspects and nuclear weapons' in BRESSLER, J.B. Environments of Man; pp.221-234; READING, MASS. ADDISON-WESLEY; 1967.

RL 511 Air Pollution; HAAGEN-SMITH, A.J; 'Air conservation' in BRESSLER, J.B. Environments of Man; pp. 235-255; READING, MASS; ADDISON-WESLEY; 1967.

RL 511 Air pollution; MULLER, H.J; 'Do air pollutants act as mutagens?' in BRESSLER, J.B; Environments of Man; pp.256-58.

RL 634 Pesticides; JOINT ABMAC/WILDLIFE EDUCATION AND COMMUNICATIONS COMMITTEE; Pesticides - a code of conduct; BRITISH AGRO-CHEMICALS ASSOC. ND; 1970.

RL 635 Pesticides; JOINT ABMAC/WILDLIFE EDUCATION & COMMUNICATIONS COMMITTEE; Some Safety Aspects of Pesticides in the Countryside; BRITISH AGRO-CHEMICALS ASSOCIATION; 1968.

RL 636 Pesticides; RUDD, R.L; Pesticides and the Living Landscape; FABER; 1965; £1.55; 320 pp.

RL 637 Irradiation (Strontium 90); COMMONER, B; Science and Survival; New York; 1967.

RL 638 Pollution; ROYAL COMMISSION ON ENVIRONMENTAL POLLUTION; 1st Report, 1971, CMND 4585; London: HMSO; £0.45; 52 pp.

RL 639 Compendium; THOMAS, W.L. Jr; Man's Role in Changing the Face of the Earth, Vols. 1 and 2; U. CHIC. PRESS 1970; £4.32; 1100 pp.

Section 4 ENVIRONMENTAL PRESSURES AND PLANNING: A FIELD STUDY

Government Publications: Many Government publications are likely to be relevant to the study made under Section 4 depending on the area and the enterprise chosen. The following lists of Government Publications may be obtained from HMSO:

RL 701 Meteorological Office; Sectional List 37.

RL 702 BUILDING; Sectional List 61.

RL 703 MINISTRY OF THE ENVIRONMENT (ex Housing and Local Government); Sectional List 5.

RL 704 FISHERIES; Sectional List 23.
RL 705 FORESTRY COMMISSION; Sectional List 31.
RL 706 OFFICE OF POPULATION CENSUS AND SURVEYS; Sectional List 56.
RL 707 AGRICULTURE AND FOOD; Sectional List 1.
RL 708 POWER; Sectional List 70.
RL 709 Miscellaneous; Sectional List 50.

Other Government Publications

RL 710 Natural Environment Research Council; Annual and Special Reports.
RL 711 CENTRAL UNIT FOR ENVIRONMENTAL PLANNING; Reports (example Humberside).
RL 712 REGIONAL ECONOMIC PLANNING COUNCILS AND BOARDS; Reports and Surveys; (NORTHERN - Welbar House, Gallowgate, Newcastle-upon-Tyne, 1. YORKSHIRE AND HUMBERSIDE - City House, Leeds. EAST MIDLANDS - Cranbrook House, Cranbrook Street, Nottingham. EAST ANGLIA - example (a) - 2 Queen Anne's Gate Buildings, Dartmouth Street, London, SW1. SOUTH EAST - example (b) - as above. SOUTH WEST - The Government Buildings, The Pithay, Bristol, 1. WEST MIDLANDS - Fiveways House, Islington Row, Birmingham, 15. NORTH WEST - Sunley Buildings, Piccadilly Plaza, Manchester, 1. SCOTLAND - St. Andrew's House, Edinburgh. WALES - Welsh Office, Cathays Park, Cardiff.)
RL 713 NATURE CONSERVANCY; Nature Conservancy Publications; 19 Belgrave Square, SW1.
RL 714 COUNTRYSIDE COMMISSION; Annual and Special Reports; 1 Cambridge Gate, Regents Park, NW1.
RL 715 SOIL SURVEY; Publications on Soil Survey (list of publications) and various detailed surveys including The Soils of Hertfordshire; The Librarian, Rothampstead Experimental Station, Harpenden, Hertfordshire.
RL 717 Soil Survey of Great Britain Field Handbook; The Librarian, Rothampstead Experimental Station, Harpenden, Hertfordshire. (out of print at present).
RL 718 Abstract of Statistics; HMSO.
RL 719 Highways Statistics; HMSO.
RL 720 Registrar-General's Quarterly Review; HMSO.
RL 721 Registrar-General's Statistical Review; HMSO.

Periodicals

RL 722 The Ecologist; ECOSYSTEMS LTD., 11 Mansfield Street, Portland Place, London W1M OAH; £0.25 mthly.
RL 723 Your Environment; quarterly; £1.50 pa.
RL 724 Town and Country Planning; Journal of the Town and Country Planning Association, 26 Portland Place, London, W1.
RL 725 Journal of TPI; Town Planning Institute, 28 King Street, London, WC2.
RL 726 The Journal of Environmental Studies; quarterly; £1.25 pa.

RL 727 Bulletin of Environmental Education (BEE); TCPA, 26 Portland Place, London, W1; monthly; £2 p.a., incl. binder.

RL 728 Nature in Focus; Bulletin of the European Information Centre for Nature Conservation; COUNTRYSIDE COMMISSION, 1 Cambridge Gate, Regent's Park, London, NW1; occasional - 3 times a year.

RL 729 Journal of Environmental Education; DEMBOR EDUCATIONAL RESEARCH SERVICES INC., Box 1605, Madison, Wisconsin 53701.

RL 730 Central Statistical Office - Social Trends; HMSO; £3.25; annually.

Film Stripe

RL 731 1. Nature Conservation in the British Isles) DIANA
RL 732 2. Architecture) WYLLIE,
RL 733 3. Water Pollution) Ltd., 3
4. Air Poilution Part 1) Park Rd,
5. Air Pollution Part 2) Baker St.,
London, NW1;
£2.50 each; colour.

Publications by other organizations

RL 734 Natural Environmental Research Council; Annual Report; HMSO, £0.65.

RL 735 Policies for the Sciences of the Natural Environment; Nat. Env. Res. Coun.

RL 736 Peak Park Planning Board; Countryside Commission.

RL 737 Civic Trust - Reports, etc. & Newsletter; 16 Carlton House Terrace, London, SW1.

RL 738 RIBA - Annual Review of Periodical Articles; 66 Portland Place, London, W1.

RL 739 Centre for Environmental Studies - Annual Reports; 3 Cambridge Terrace, Regent's Park, London, NW1.

Conservation and Planning Legislation

RL 740 BARR, J; The Environmental Handbook; pp.273-287; PANN; 1971; £0.40; 334 pp.

RL 741 GRESSWELL, P; Environment; An Alphabetical Handbook; MURRAY; 1971; £3.75.

RL 742 LAYFIELD, F.H.B; Powers for Conservation; MURRAY; 1971; £3.75; 297 pp.

RL 607 CULLINGWORTH, J.B. (see RL 607 above).

RL 630 FAIRBROTHER, N. (see RL 630 above).

RL 743 KEELE, L; Principles and Planning of Town and Country Planning; ESTATES GAZETTE (4th edition); 1964; £5.50; 380 pp.

RL 744 ASH, M; Regions of Tomorrow; EVELYN, ADAMS, McKAY; 1969; £1.75; 100 pp.

RL 745 List of material usually available from Planning Departments; HERTFORDSHIRE COUNTY COUNCIL.

RL 746 Special reports of a Planning Department, e.g. Letchworth, Ware, Hoddesdon; PLANNING DEPARTMENT, HERTFORDSHIRE COUNTY COUNCIL.

Country Planning - Rural Environment

RL 747 BRACEY, H. E; People and the Countryside; Routledge, Kegan Paul; 1970; £3.15; 304 pp.

RL 627 ACTON SOCIETY TRUST.

RL 604 ROSKILL COMMISSION (see RL 604 above).

RL 612 BARBER, D., (see RL 612 above).

RL 611 WELLER, J., (see RL 612 above).

RL 613 BRETT, L., (see RL 613 above).

RL 614 HACKETT, B. (see RL 614 above).

RL 748 GILCHRIST & SHIRLAW; Agricultural Geography of Great Britain; PERGAMON, 1966; 162 pp.

RL 749 CHRISTIAN, G; Tomorrow's Countryside; MURRAY; 1966; £2.25; 220 pp.

RL 750 STAMP, D; The Land, Its Use and Misuse; LONGMANS; Third Edition; 1962; £5.25; 500 pp.

RL 600 TETLOW, J. and GOSS, A. (see RL 600 above).

RL 606 WARD, P. (see RL 606 above).

RL 587 DYOS, H. L. (see RL 587 above).

RL 605 OSBORN, F. J. and WHITTICK, A. (see RL 605 above).

RL 602 CULLEN, C. (see RL 602 above).

RL 603 WORSKETT, R. (see RL 603 above).

RL 753 JONES, E. Towns and Cities; OUP; 1966; 37½p. 152 pp.

RL 754 OSBORN, F. J; Green Belt Cities; EVELYN, ADAMS AND MACKAY; 1969; £1.75; 203 pp.

RL 755 THOMAS, D; London's Green Belt; FABER; 1970; £3.25; 247 pp.

RL 756 MIN. OF HOUSING AND LOCAL GOVERNMENT; Historic Towns, Preservation and Change; HMSO; £1.50; 49 pp.

RL 757 HUDSON, K; Industrial Archaeology; JOHN BAKER; 1963; £1.75; 179 pp.

RL 752 STORM, M; Urban Growth in Britain; OUP; 1967; 60 p, 64 pp.

RL 758 LOMAS, G. M; Social Aspects of Urban Development; NATIONAL COUNCIL OF SOCIAL SERVICE; 1966; 50p; 91pp.

RL 764 CAMBRIDGESHIRE COUNTY COUNCIL, PLANNING DEPARTMENT; Urban Buildings and a Guide to the Law; CAMBRIDGESHIRE CC; 1971; 50p; 100 pp.

RL 761 SHARP, T; Town and Townscape; JOHN MURRAY; 1968; £2.50; 156 pp.

RL 759 NAIRN, I; Britain's Changing Towns; BBC; 1967; £1.75; 168 pp.

RL 760 MEDHURST, B. F. and PARRY LEWIS, J; Urban Decay; MACMILLAN; 1969; £3.25; 174 pp.

RL 762 MADGE, J., SMEE, M. and BLOOMFIELD, B; Work Book for People in Towns; BBC; 1968; 75p; 97 pp.

RL 763 BRUNSKILL, W; Illustrated Handbook of Vernacular Architecture; FABER; 1970; £2.50; 229 pp.

Forestry

RL 621 MILES, R. (see RL 621 above).

RL 622 EDLIN, H. L. (see RL 622 above).

RL 765 FORESTRY COMMISSION; Census of Woodlands; HMSO; 1970; 60p, 170 pp.

RL 766 FORESTRY COMMISSION; Forestry in the British Scene; HMSO; 1968; 50p; 80 pp.

RL 768 FORESTRY COMMISSION; Public Recreation in National Forests; HMSO; 1968; 50 p; 100 pp.

Recreation

RL 63 FURON, R.

RL 625 KLEIN, L, (see RL 625 above).

RL 769 BURTON, T; Recreation, Research, Planning; ALLEN & UNWIN; 1970; £3.25; 270pp.

RL 770 BEAZLEY, E; Designed for Recreation; FABER; 1969; £5.50; 215 pp.

RL 771 DOWER, M; The Challenge of Leisure; CIVIC TRUST; 1965; 37p, 60 pp.

RL 772 PATMORE, J.A; Land and Leisure; DAVID & CHARLES 1970; £4.20; 330pp.

RL 773 HMSO; Future Management of Water in England and Wales; HMSO; 1971; 70p; 108 pp.

Field Work and Interpretation

RL 785 CLARKE, J; Population Geography; OXFORD; PERGAMON; 1965; £1.50; 160 pp.

RL 620 BAKER, HAMPSHERE, LANGTON.

RL 774 JACKSON, J.N; Surveys for Town and Country Planning; HUTCHINSON; 1968; 60p; 192 pp.

RL 775 HANCOCK and WHITLEY; Geographer's Vademecum; PHILLIPS; 1971; 50p; 124 pp.

RL 776 FULLARD, H; Geographical Digest 1971; PHILLIP; 60p; 100pp.

RL 777 WHEELER, A; Geography in the Field; BLOND; 1970; £1.75; 212pp.

RL 778 CORFE, T; History in the Field; BLOND; 1970; £1.50; 153 pp.

RL 779 EMMISON, F.G; Archives and Local History; METHUEN; 1966; £1.50.

RL 780 ARCHER and DALTON; Fieldwork in Geography; BATFORD; 1966; £2.25; 210 pp.

Statistics

RL 761 MORONEY, M.J; Facts from Figures; PELICAN; 1970; 45p; 200 pp.

RL 762 CROCKER, A.C; Statistics for the Teacher; PELICAN; 1970; 42p; 200 pp.

RL 783 COOPER, B.M; Writing Technical Reports; PELICAN; 1967; 20p; 150 pp.

Services

RL 734 WARREN SPRING LAB; Air Pollution; Min. of Technology; 1970; 6pp. (various specialist leaflets).

RL 788 CEGB; Electricity in the Environment; CEGB; 1970; 24 pp.

Films

RL 789 Wildlife in the city; Survival-London; BRITISH FILM INSTITUTE; £1.50 per day; 30 mins. B&W; 16 mm.

RL 790 Deforestation; Survival - The Unprotected Deer; BFI; £1 per day; 20 mins; B&W; 16 mm.

RL 791 Water Pollution; The River must Live; Petroleum Film Bureau; free; 21 mins; colour; 16 mm.

RL 792 Planning and Traffic; Traffic Island; BFI; £1 per day; 16 mins; colour; 16 mm.

RL 793 Case Studies of Animal Populations - History of Human Cultures, current conflicts; The Time of Man; EALING SCIENTIFIC; Catalogue No.90-0613/4; 50 mins; colour; 16 mm.

RL 794 Refuse Disposal; Refuse Disposal; RANK FILM LIB; 75p. per day; 13 mins; B&W; 16 mm.

RL 795 Sewage; Sewage Disposal; RFL; 75p. per day; 10 mins; B&W; 16 mm.

Loops - all approx. £5.00

RL 798 Urban Ecology; The Urban Ecology Series

1. Vacant lots 81/7635/1
2. Garbage dumps 81/7643/1
3. What's in the air? 81/7650/1
4. Water in the city 81/7668/1
5. The city as a human habitat 81/7676/1

All from EALING SCIENTIFIC; 4 mins; Super 8 mm.

RL 797 Energy Inputs of a Modern City; Energy for the City; EALING SCIENTIFIC; 85/0865/1; 4 mins; super 8.

RL 798 Density using Aerial Photography; Size of the City; EALING SC; 87-0816/1; 4 mins; super 8.

RL 799 Conflicts; Renewing the City; EALING SC; 87-0832/1; 4 mins; super 8.

RL 800 Waste - Poverty; Problems of the City; EALING SC; 87-0881/1; 4 mins; super 8.

Film Strips

RL 801 An introduction to techniques in urban field work; How to look at a Town; JOHN KING FILMS; CGA324; £1.12½; B&W.

RL 802 Demand and supply, balance of resources base; Science and Natural Resources Series

1. Can the biologist meet the demand?
2. Can the chemist renew the supply?
3. Can the physicist and engineer strike a balance?

ENC. BRIT; 9170; £4.50 for series; colour.

RL 803 Geography; Regional Geography of Great Britain series of - with maps; JOHN KING; £1.50 each; colour.

RL 804 Examples; Field Study Series, with maps; JOHN KING; £1.75 each; colour.

RL 805 Recognition; Land Use Crop Recognition; JOHN KING CGA 811; £1.50; Colour.

RL 806	Pollution; Pollution; Set of six strips with records; EALING SCIENTIFIC;	
	1. The Pollutors	87-1970/6
	2. Air	87-1988/6
	3. Water	87-1996/6
	4. Land	87-2002/6
	5. Noise	87-2010/6
	6. The Problem is Now	87-2028/6
	£25 for the set; colour.	
RL 807	Aerial photographs - available from most county councils.	

EQUIPMENT

It is anticipated that schools will already have at their disposal quantities of apparatus required by various subject disciplines. Many of the following items will probably be in schools as part of normal Biology/Physics/Geography/Environmental Studies provision. However, this list is provided as a guide, to ensure that apparatus that will be of great use to those involved in the teaching of this syllabus might be made available - either from existing departmental stocks or by special purchase. Basic equipment (prisms, mirrors, lenses, etc.) is not included.

Key to Suppliers

C & D	C & D (Scientific Instruments) Ltd., 439a London Road, Boxmoor, Hemel Hempstead, Herts.
G & G	Griffin & George, Ltd., Ealing Road, Alperton, Wembley, Middx., HAO 1HJ.
P H	Phillip Harris, Ltd., 63 Ludgate Hill, Birmingham, B3 1DJ.
P K D	P. K. Dutt & Co. Ltd., 113 Lavender Hill, Tonbridge, Kent.
Unilab	Rainbow Radio Ltd., Blackburn, Lancs.
Mettoy	Education Division, The Mettoy Co. Ltd., 14 Harlestone Road, Northampton, NN5 7AF.
B D H	British Drug Houses, Pool, Dorset.
S R I	Scientific & Research Instruments Ltd., 335 Whitehorse Road, Croydon, Surrey.
Silva	Black & Edgington Ltd., Ruxley Corner, Sidcup, Kent.
Casella	C. F. Casella & Co. Ltd., Regent House, Britannia Walk, London, N17ND.
Polaroid	Polaroid Land Ltd., Rosanne House, Welwyn Garden City, Herts.
C U P	Cambridge University Press, Bentley House, PO Box 92, 200 Euston Road, London, NW1.

Section 1.1	THE SOLAR SYSTEM	Source of Supply
E1	Turntable and Motorized Sphere attachment	G & G
E2	Circular motion apparatus	G & G
E3	Planetarium Model (Helios)	Mettoy

Section 1, 1, 1	Source of Supply
E4 Nuffield Energy Conversion Kits	G & G or P H
E5 Radioactivity apparatus - cloud chambers, etc.	G & G
E6 30 mm. Wave apparatus and accessories	G & G or Unilab
E7 Infra-red detector	G & G
E8 Ultra-violet source	G & G
E9 Discharge tubes and power supply	G & G
E10 Direct vision spectrascope	G & G
E11 Ripple tank (demonstration type) Stroboscope, etc.	G & G

Section 1, 4 THE BIOSPHERE and Section 2 THE ECOSYSTEM

(Apparatus requirements for these two areas of the syllabus have been considered collectively since items will clearly be used in both).

Section 1, 4, 1 Concept of the circulation of elements

E12 Oxygen meter (1520 and 1521 electrodes)	Electronic Instruments Ltd., Richmond, Surrey. Details available from Warren Springs Laboratories, Stevenage, or Public Health Officers.

Section 1, 4, 2 Methods of obtaining Energy

E13 Ergometer	G & G
E14 Student kymograph	G & G and SRI
E15 Spirometer	S R I
E16 Calorimeter	G & G

Section 2 - Field Study - THE ECOSYSTEM

(a) Met. apparatus to include:	
E17 Soil thermometer)	
E16 Wind vane)	Casella
E19 Hygrometer (hair and whirling), hygrometric)	G & G
tables)	P H
E20 Max/Min. thermometer)	et. al.
E21 Wet/Dry thermometer)	
E22 Rain gauge)	
E23 Stevenson screen)	
E24 Anemometer)	
(b) Soil testing apparatus:	
E25 B D H capillator	
E26 B D H soil testing kit	B D H/P H
E27 Mineral soil testing kit (Sudbury app.)	G & G or P H or P K D

	Source of Supply
(c) Surveying Apparatus:	
E28 Plane table)	
E29 Alidade)	G & G
E30 Land chain)	P H
E22 Clinometer)	et. al.
E33 Ranging rods)	
E34 Spirit level)	
E35 Tapes)	
E31 Field compasses	Silva
(d) Miscellaneous:	
E36 Geological hammers	P K D
E37 Plastic aquaria aerators, etc.	G & G
E38 Collecting nets, various	G & G/P H/P K D
E39 Small mammal traps (Longworths)	P K D
E40 Insect cages	P K D
E41 Mammal cages, vivaria, etc.	P K D
E42 Stereo microscope	C & D/G & G
E43 Spring balance	G & G/P H
E44 Polaroid land camera	Polaroid
E45 Environmental comparator and colorimeter (with accessories)	G & G
E46 Environmental chamber	G & G
E47 Atmospheric pollution meters (details of construction/loan facilities available from Warren Springs Lab. Stevenage)	
E48 Magnifiers	C & D et al.
E49 Soil augers	G & G/P H/P K D
E50 Quadrant frames, point frames, etc.	G & G/P K D
E51 Tables of random numbers	C U P
E53 Maps (OS soil, survey, geological)	Ordnance Survey

Section 3 THE INTERACTION OF MAN AND THE ENVIRONMENT

E52 Tape and recorder (portable) — Philips/Sony

Section 4 ENVIRONMENTAL CONFLICTS AND PLANNING - A FIELD STUDY

Apparatus selected from above as required.

Visual Aid Apparatus

It is anticipated that considerable use will be made of visual aid equipment; the following items are therefore essential :

16 mm. projector
Strip/slide projector
Loop projector (Super 8 specification for most loops recommended).